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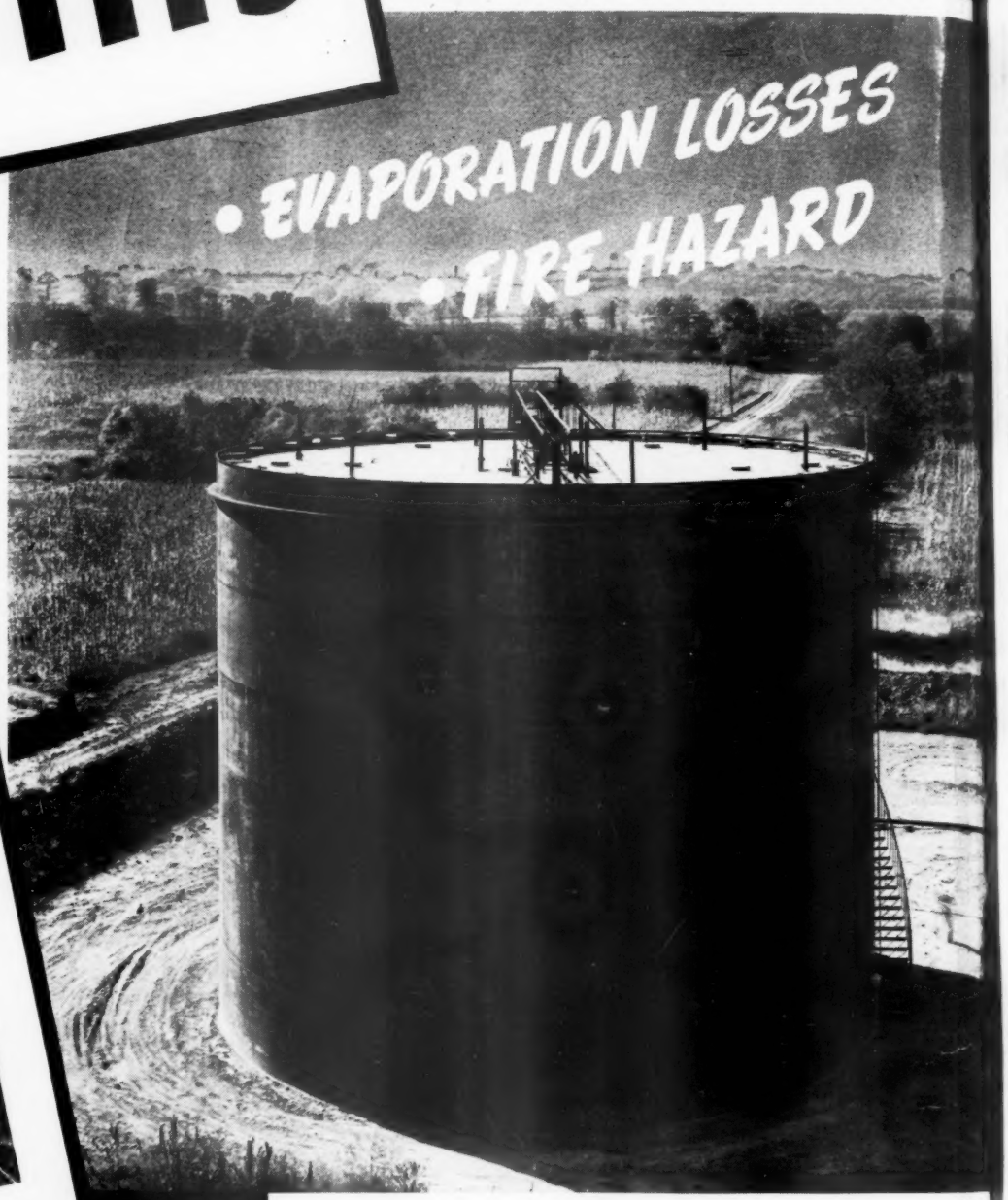

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Looking Around

By THE OBSERVER

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APRIL • 1947
VOLUME XVIII NUMBER 7

the Petroleum Engineer

...ls for Operating Men

MEETINGS

April 30-May 1-2—American Gas Assn., Spring meeting, Stevens Hotel, Chicago, Ill.

May 4-7—Petroleum Equipment Suppliers Assn. annual meeting, Mark Hopkins and Fairmont Hotels, San Francisco, Calif.

May 6-8—Petroleum Industry Electrical Assn. and Petroleum Electrical Supply Assn., Rice Hotel, Houston, Texas.

May 6-8—Southwestern Gas Measurement Short Course, Univ. of Oklahoma, Norman.

May 8-9—Independent Petroleum Assn. of America, mid-year meeting, Jackson, Miss.

May 7—Institute of Petroleum, Manson House, 26, Portland Place, London, W. 1.

May 12-17—First South American Petroleum Congress (ISAP), Lima, Peru.

May 15-16—Indiana Gas Assn., Springs Hotel, French Lick.

May 15-16—API Pacific Coast District, Biltmore Hotel, Los Angeles, California.

May 15-22—Southern California Meter Assn., Rio Hondo Club, Downey.

May 20-22—Pennsylvania Gas Assn., Wernersville, Pa.

May 21-24—ASME, Oil and Gas Power Division, Cleveland, Ohio.

May 22-23—API Mid-Continent District, Herring Hotel, Amarillo, Texas.

May 22-23—Natural Gas and Petroleum Assn. of Canada. Annual meeting, Royal Cannaught Hotel, Hamilton, Ontario.

May 27-30—Gas technology short course, Texas College of Arts and Industries, Kingsville.

June 1-6—Society Automotive Engineers, Summer transportation meeting, French Lick Springs Hotel, French Lick, Ind.

June 2-3—API, Refining Division, Jefferson Hotel, St. Louis, Mo.

June 7—California Natural Gas Association, Annual Frolic, Rio Hondo Golf Club, Los Angeles.

June 11—Institute of Petroleum, Manson House, 26, Portland Place, London, W. 1.

June 16-18—Canadian Gas Association, General Brock Hotel, Niagara Falls, N. Y.

June 16-20—ASTM, 50th annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Sept. 15-17—National Butane-Propane Assn., annual meeting, Jefferson Hotel, St. Louis, Mo.

Oct. 7-8—American Gas Assn., annual meeting, Cleveland, Ohio.

Oct. 10—California Natural Gas Assn., Fall meet, Ambassador Hotel, Los Angeles.

Oct. 21-25—Pacific Chemical Exposition, Civic Auditorium, San Francisco, Calif.

Nov. 6-7—SAE, Fuels and Lubricants meeting, Hotel Mayo, Tulsa, Okla.

Dec. 1-5—ASME, annual meeting, Chalfonte and Haddon Hall, Atlantic City, N. J.

Jan. 12-16, 1948—SAE, annual meeting, Book-Cadillac Hotel, Detroit, Mich.

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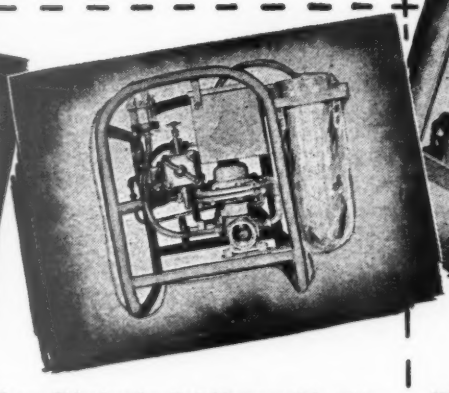

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The course of OIL

AVOIDABLE CORROSION LOSSES

Soil corrosion is one of the most prevalent and insidious problems besetting industry today. The magnitude of losses incurred from just this one type of corrosion is staggering. According to the U. S. Bureau of Standards, pipe line replacements cost industry approximately 200 million dollars annually, due to corrosion. This is an economic loss so serious that it may well enlist the full support of the top managerial and technical minds in the industry in a concerted effort towards its reduction or elimination.

It is not as if there were no solutions to the soil corrosion problem—there are. One of the most effective of these is cathodic protection. In an article presented at Chicago this month before the National Association of Corrosion Engineers, H. H. Anderson bluntly states: "what about us in industry who are *needlessly* (the italics are ours) paying billions for a show we can't even see?" and emphasizes that word "*needlessly*, because much of the damage can be stopped by cathodic protection if we will appreciate and apply this simple principle disclosed by Sir Humphrey Davy in 1824." Of cathodic protection, he goes on to say that it "can save industry from myriad costly service breakdowns, commodity losses, customer ill-will, and plant repairs and renewals. Yet many corrosion engineers tell me that a prime limitation on its use is that management is not yet sold on it. These ardent exponents know how simply it works, how great is its value, how tangible is its economy, and how it warrants a broader acceptance." Anderson suspects that "many engineers have confused instead of enlightened the boss with too much detail while trying to explain facts that seem obvious to them."

The application of cathodic protection is good business. Solutions to the problem of cathodic protection "call for data, science, and experience, mixed with plenty of plain horse sense." Anderson concludes his forthright article by pointing out that "our corrosion engineers will work them out for us and lessen thereby industry's heavy losses from soil corrosion to the extent that we afford them (our corrosion engineers) the opportunity and lend our sympathetic support."

The economic loss by neglecting this problem of soil corrosion is too great to pass over it with apathy. Soil corrosion no longer need be accepted as a necessary evil. It can be combated successfully and economically. In order to foster better management understanding of cathodic protection—the nemesis of soil corrosion—an inter-industry committee has been formed comprising members from eight trade associations, two national communication systems, and a live-wire engineering association. If the efforts of this committee result in a general concerted effort by all industry to eradicate most of the losses arising from soil corrosion, an important step, far-reaching in its economic gains, will have been made. (Mr. Anderson's article will appear in the May issue.)

STRIPPER WELL PROBLEM

Stripper wells in the oil industry are in the same category as low grade ores in the mining industry. During times of high crude prices stripper wells can be operated profitably, just as low grade ores can be mined profitably when metal prices are high.

When prices are low, however, the stripper well operator may confront a serious situation. If all his production is obtained from stripper wells he may not be able to operate his wells at a profit and so may have no recourse but to shut his wells in or he may have to abandon them, depending upon the condition of his wells, and whether he can afford to weather a period of low crude prices.

This is essentially the problem of the stripper well operator. So far as he himself is concerned, it is a question of economics. When he is compelled to plug and abandon his wells, however, and leave the oil in the ground during a period of national oil scarcity, it goes beyond the stripper well operator's concern.

ENFORCING GAS CONSERVATION

Despite the inconvenience that it imposes on operators, there is a healthy regard throughout the industry for the efforts of the Texas Railroad Commission to restrict the flaring of gas in Texas fields. This is not surprising in view of the fact that gas associated with oil underground is a valuable agent in reducing lifting costs, in repressuring operations, as a source of energy, and as an ultimate source of revenue. As improved producing techniques are developed and the market for gas expands, the profligate waste of gas will become *passé*.

Efforts now being made within the industry to extend the scope of secondary recovery operations have also an important bearing on gas conservation. A backlog of knowledge in secondary recovery technique has been developed that merits its wider adoption and application. Many secondary recovery projects now under consideration will require vast quantities of gas for their operation. Modern secondary recovery practices to increase oil recovery and gas conservation therefore go hand in hand.—K.C.S.

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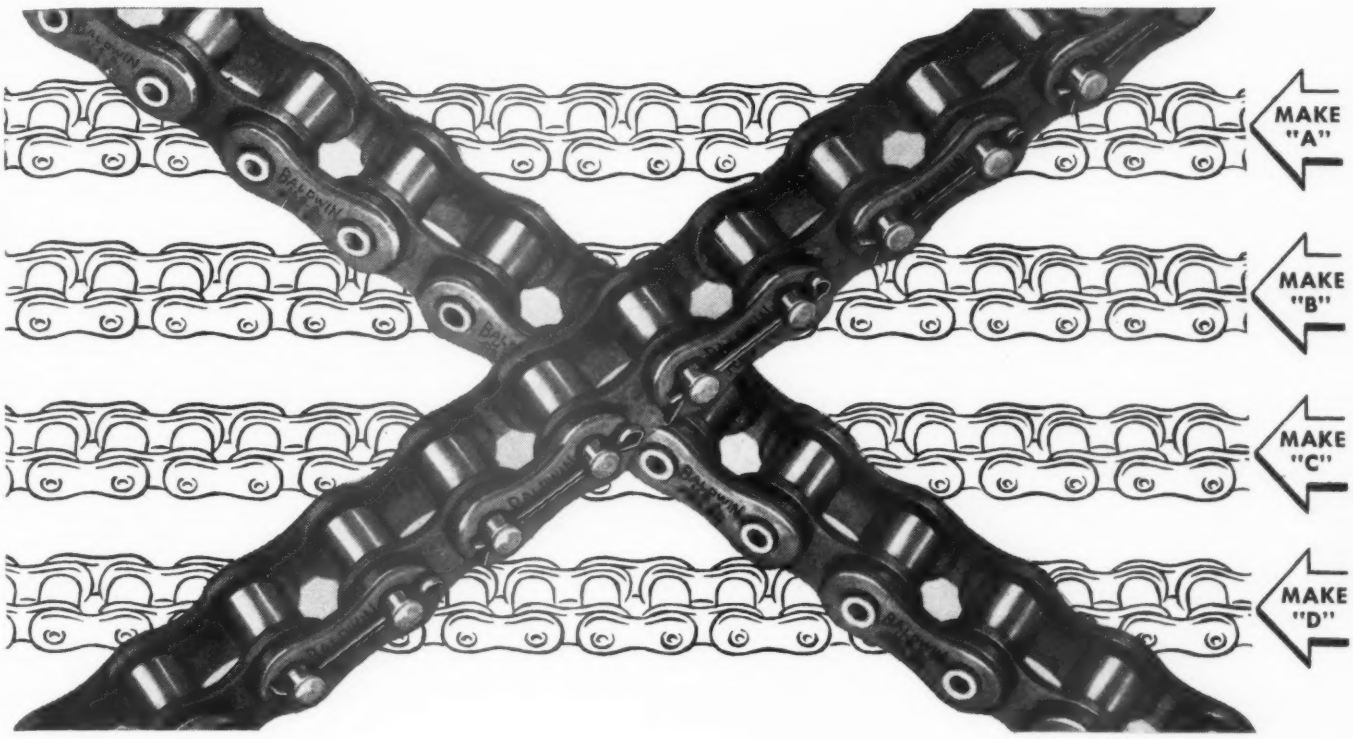

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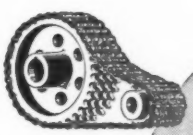

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SCANNING WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—The search is on for a way out of the industry's supply dilemma—how to avoid a fuel oil shortage next winter and still meet gasoline demand this summer, lest the calamity howlers say "Ickes was right, we are running out of oil."

Of course, even if spot shortages of gasoline develop, that does not prove Ickes was correct. It is a short-term problem. Given the steel, the industry is confident that it can work itself out of the hole.

Unfortunately for the industry's relations with the public now, shortage of steel is preventing the drilling of more wells, construction of pipe lines, and expansion of refineries needed to satisfy the record-high demands, which are outstripping the forecasters.

Military authorities are laying their cards on the table, telling of their difficulties in obtaining supplies for current requirements, not to mention additional quantities to build back inventories. The totals involved stagger industry leaders, already worried over meeting civilian requirements.

But what can be done—that is the question.

Some independent refiners and distributors have appealed to Washington for a return to wartime allocation of crude supplies and products. But they have been told by the Interior Department that the industry is entirely on its own now. Max W. Ball, director of Interior's Oil and Gas Division, replied to one appeal, as follows:

"Inasmuch as wartime controls over the allocation of crude oil have been removed and the petroleum industry restored completely to operation by private enterprise, the federal government is without authority to intervene to obtain crude oil supplies for individual refiners. Moreover, in the existing circumstances, any such government action almost inevitably would result in depriving one refiner of crude oil for the benefit of another. Obviously, such government interference would be both undesirable and unwise and could lead only to the most unfortunate results."

Suggestion that industry groups be set up for voluntary programming of refinery output and distribution immediately raises the specter of the Madison oil case. But it may come to that, eventually. The Department of Justice may be asked to give a "green light" under the antitrust laws for such a plan, including the sharing of crude supplies and transportation facilities.

Even with oil imports running at nearly 500,000 bbl a day in recent months, the possibility of bringing in more foreign crude and products is being actively explored now.

Some people are willing to bet that Middle East fuel oil will be delivered to the United States before another year rolls around. Indeed, the prospect of more fuel oil from Abadan, world's largest refinery at head of the Persian Gulf, is one inducement the British are offering in seeking to buy another 50 tankers from the Maritime Commission.

At present Abadan operations have been curtailed due to lack of tankers. British say they will have to get their supplies at the Gulf or from East Coast, taking delivery in American tankers and further tightening situation here. Maritime Commission is facing the fact that Congress does not want the government operating tankers after June 30 yet the industry has bought all the boats it wants and there are still not enough in service to meet present emergency requirement.

One step the government probably will take is an attempt to step up production of line pipe, so that more oil and gas lines can be laid before the snow flies. Also, a study may be made of the possibilities of scheduling pipe line projects so as to satisfy the fuel requirements of as many consumers as possible in the shortest possible time.

A survey of the large diameter pipe situation by Interior's inter-departmental petroleum committee served to confirm fears that the pipe mills were far behind pending projects, domestic and foreign.

The report indicates that, as of March 15, pending projects would require about 21,000 miles of 12 to 30-in. pipe totaling about 4,000,000 tons. Of these totals, domestic gas line projects —pending or approved by Federal Power Commission—accounted for about 14,000 miles and over 2,500,000 tons of pipe. Domestic and foreign crude oil lines make up the balance (product pipe lines were not covered in the survey). To meet the indicated requirement of 3,700,000 tons of 16-in. or larger pipe would require that the pipe mills, capable of making this size, operate for more than three years at capacity, making this large pipe only. Actually, the mills are well under capacity now because of shortage of steel billets and plates.

Interior's pipe report was purely factual. There were no recommendations that some sort of priorities system be attempted or that domestic projects be favored over foreign. But a fight against export of line pipe (and tubular goods) can be expected from the domestic producers as well as some refiners, perhaps. It remains to be seen whether the White House will attempt to allocate pipe to oil and gas lines needed in the Middle West, if voluntary efforts fail.

As if the shortages in themselves were not enough to plague the industry, there is also the prospect of new antitrust cases involving increases in gasoline prices after the recent crude advance.

Senators and governors took pen in hand to back up consumer complaints against higher gasoline prices, demanding that Attorney General Tom Clark take action. After a preliminary investigation, Clark replied that a new price-fixing case would be instituted, if the facts warrant.

Indications are that one of the cases, if brought, will be on the West Coast. Clark did not say whether it would be a criminal or civil proceeding, but it might involve a grand jury investigation either way. He has promised an announcement within a few weeks. And that probably means early in May, just before the new deadline—May 16—for the government to object to or answer the Sun Oil Company's interrogatories in the API-Mother Hubbard antitrust suit.

The flurry of price complaints did not go unchallenged from the industry. Russell B. Brown, IPAA general counsel, pointed out that the product price increases simply reflected the higher postings for crude which, in turn, were needed to stimulate wildcatting. If the present price advance does not produce that result, "then obviously it will require more," Brown added. This is the only sure way to avoid a return to rationing of petroleum products, he declared.

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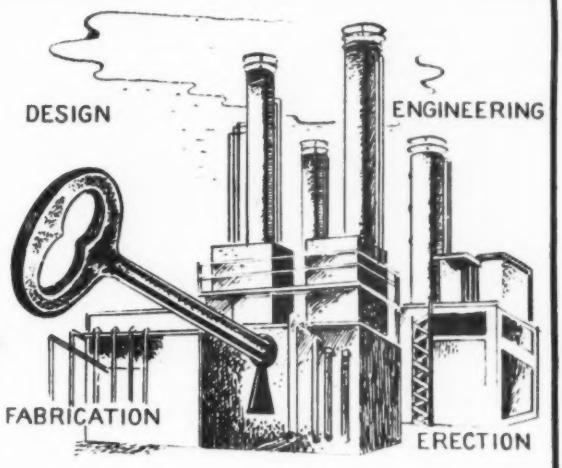

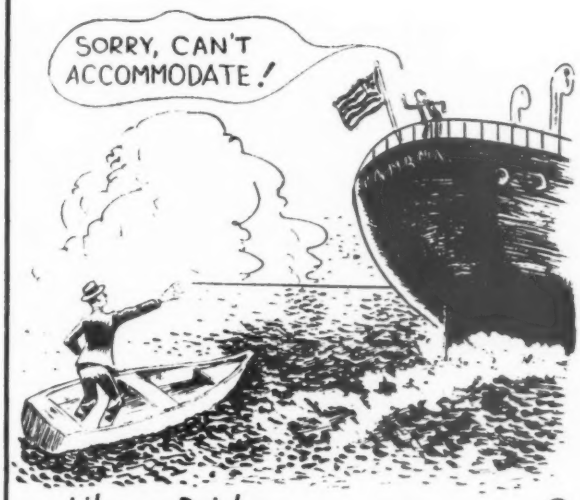

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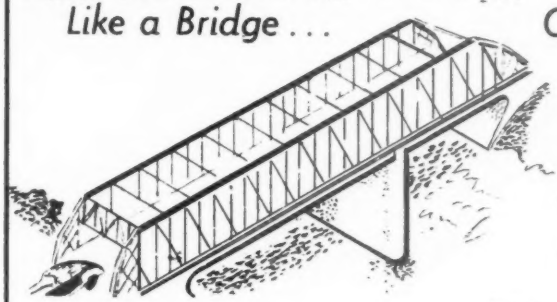

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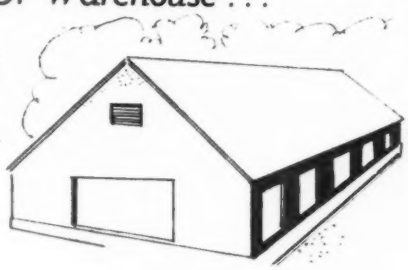

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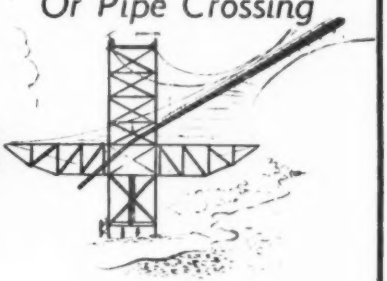

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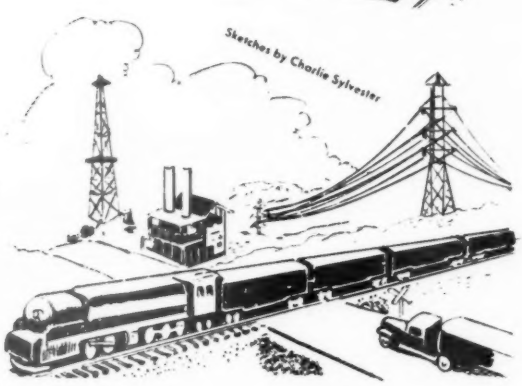

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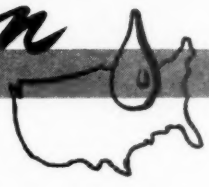


By H. J. STRUTH,* *Petroleum Economist*

SUPPLY AND DEMAND. Supply of all oils in first quarter of 1947 was 5,596,000 bbl daily, against 5,262,000 bbl last year. Production increased 185,000 bbl daily over last year, imports rose 131,000 bbl and natural gasoline output was up 18,000 bbl daily. Gain in supply was 334,000 bbl daily. Demand, same period, averaged 5,860,000 bbl, against 5,256,000 last year. Gain in demand was 604,000 bbl daily.

*Editor, *The Petroleum Data Book.*

GAINS IN DEMAND. Crude demand in March averaged 5,011,000 bbl daily, approaching peak of last July and August of 5,107,000 bbl. Demand in first quarter was 5 per cent above last year. Motor fuel demand in first quarter averaged 2,040,000 bbl, which is 7 per cent above 1946 quarter. Fuel oil demand increased 11 per cent. Demand for all refined products was up about 10 per cent.

BALANCED PRODUCTION SITUATION. Production of crude oil runs to refinery stills in the first quarter of 1947 were maintained at economic levels. Crude production averaged 4,766,000 bbl daily, against normal market requirements of 4,750,000 bbl. Refinery still runs equaled market requirements in first quarter, with average daily runs of 4,820,000 bbl. These figures represent requirements without consideration of stock changes.

STOCKS BELOW REQUIREMENTS. Continued withdrawals of fuel oil and products other than motor fuel from storage since January 1, have placed the industry's stock position below projected seasonal needs. Measurement of stocks of all oils at the close of March with projected market requirements places the normal stock level at about 514,300,000 bbl, whereas stocks on March 31 aggregated 483,300,000 bbl. The stock level is now about 6 per cent below normal.

PRICES ABOVE 1926. Recent price advances have for the first time in many years brought the index above the 1926 level. The average price of crude oil in the United States is now $1.92, reflecting the latest advance in Pennsylvania, which compares with an average of $1.88 per bbl in 1926.

Comparative Statistics, March, 1947

*All figures are computed on a Bureau of Mines' Basis**

	March 1947(p)	Feb. 1947(p)	March 1946	This year to date	Last year to date	Per cent change
Wells drilling	3,730	¶3,710	3,610	3,730	3,610	+ 3
Total wells drilled§	2,444	2,201	2,329	7,158	6,640	+ 8
Development wells	2,080	1,852	1,977	6,054	5,699	+ 6
Oil	1,315	1,144	1,217	3,758	3,558	+ 6
Gas	255	246	217	760	617	+23
Dry§	510	462	543	1,536	1,524	+ 1
Per cent dry	24.5	24.9	27.5	25.4	26.7	— 1.3
Wildcat wells	364	349	352	1,104	941	+17
Oil	57	47	57	146	134	+ 9
Gas	11	14	7	35	25	+40
Dry	296	288	288	923	782	+18
Per cent dry	81.3	82.5	81.8	83.6	83.1	+ 0.5
Crude supply*	157,600	141,100	143,647	449,690	432,848	+ 4
Daily average	5,084	5,039	4,634	4,997	4,809	
Crude demand	155,350	139,400	149,546	449,550	430,179	+ 5
Daily average	5,011	4,979	4,824	4,995	4,780	
Crude stocks	233,000	¶230,500	225,928	233,000	225,928	+ 3
Days supply	46	46	47	46	47	
Natural gasoline production	10,300	9,200	9,323	30,152	28,216	+ 7
Daily average	332	329	301	335	314	
Motor fuel production	66,975	59,850	61,899	194,585	179,517	+ 8
Daily average	2,160	2,138	1,997	2,162	1,995	
Gasoline yield, per cent	39.3	39.3	37.6	39.7	37.8	+ 1.9
Motor fuel demand‡	65,175	56,610	62,191	183,585	171,355	+ 7
Daily average	2,102	2,022	2,006	2,040	1,904	
Motor fuel stocks△	103,300	101,500	101,844	103,300	101,844	+ 1
Days supply	49	50	51	49	51	
Fuel oil production	63,480	56,000	62,896	180,410	183,064	— 1
Daily average	2,048	2,000	2,029	2,005	2,034	
Fuel oil demand‡	77,800	73,700	64,860	233,500	209,944	+11
Daily average	2,510	2,632	2,092	2,594	2,333	
Fuel oil stocks	73,900	81,600	62,917	73,900	62,917	+17
Days supply	29	31	30	29	30	
Refinery still runs	151,060	134,600	144,488	433,820	414,850	+ 5
Daily average	4,873	4,807	4,661	4,820	4,609	
All refined stocks	250,300	¶259,000	238,216	250,300	238,216	+ 7
Days supply	44	45	48	44	48	

Economic Position of U. S. Petroleum Industry

Three Months Ending March 31, 1947

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	7,650	6,744	88
Production (daily crude output)	4,750	4,766	100
Refining (daily still runs)	4,820	4,820	100
Stocks (crude and refined)	514,300	483,300	94
Price of crude (per bbl)	1.88**	1.92	102

Current Crude Oil Prices

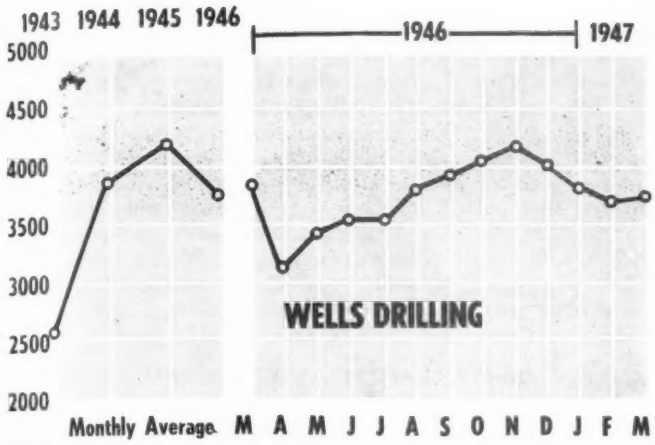
U. S. average	$1.92	Louisiana	$1.92	**Basic crude prices**	
Texas	1.91	Arkansas	1.73	Oklahoma-Kansas (36 gr.)	$1.87
California	1.66	New Mexico	1.70	Texas Gulf Coast (36 gr.)	2.07
Oklahoma	1.93	Mississippi	1.72	East Texas	1.95
Kansas	1.92	Illinois	2.06	West Texas (36 gr.)	1.74
		Other states	2.53	California Signal Hill (26 gr.)	1.71
				Pennsylvania, Bradford	3.91

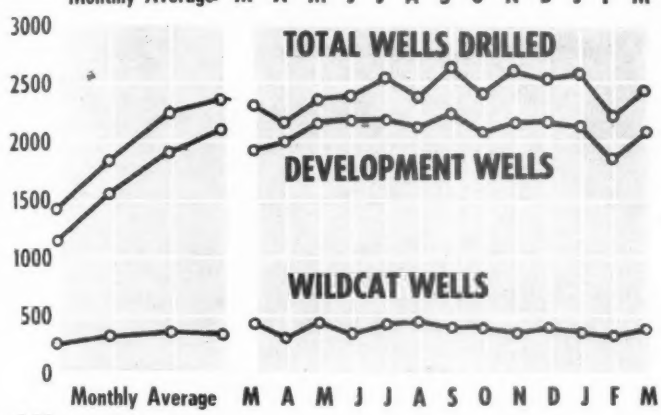
Drilling and Production Statistics by States

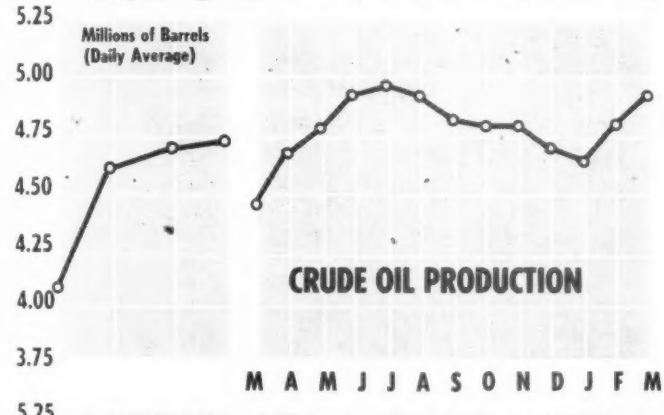
	March 1947(p)	Feb. 1947(p)	March 1946	This year to date	Last year to date	Per cent change
Total wells drilled§	2,444	2,201	2,329	7,158	6,640	+ 8
Texas	716	648	675	1,989	1,909	+ 4
California	125	155	162	450	442	+ 2
Oklahoma	330	332	200	1,013	595	+70
Kansas	193	200	159	604	487	+24
Louisiana	93	94	120	289	317	— 9
Arkansas	21	14	10	58	40	+45
New Mexico	52	39	34	133	106	+25
Mississippi	30	22	24	87	61	+43
Illinois	166	126	173	458	486	— 6
Other states	718	571	772	2,077	2,197	— 5
Wildcats drilled	364	349	352	1,104	941	+17
Texas	159	120	148	395	348	+14
California	26	25	26	76	64	+19
Oklahoma	58	91	38	221	120	+84
Kansas	24	25	18	78	65	+20
Louisiana	23	14	27	57	52	+10
Arkansas	3	3	2	11	8	+38
New Mexico	3	5	4	13	16	—19
Mississippi	2	9	12	22	22	0
Illinois	21	20	26	81	91	—11
Other states	45	37	51	150	155	— 3
Daily crude production	4,861	4,794	4,414	4,766	4,581	+ 4
Texas	2,148	2,065	1,825	2,055	1,985	+ 4
California	901	876	852	886	846	+ 5
Oklahoma	363	366	359	362	377	— 4
Kansas	267	274	251	265	253	+ 5
Louisiana	419	419	375	420	376	+12
Arkansas	79	78	76	78	77	+ 1
New Mexico	105	107	99	106	98	+ 8
Mississippi	86	85	54	86	55	+56
Illinois	187	191	208	192	208	— 8
Other states	306	333	315	316	306	+ 3

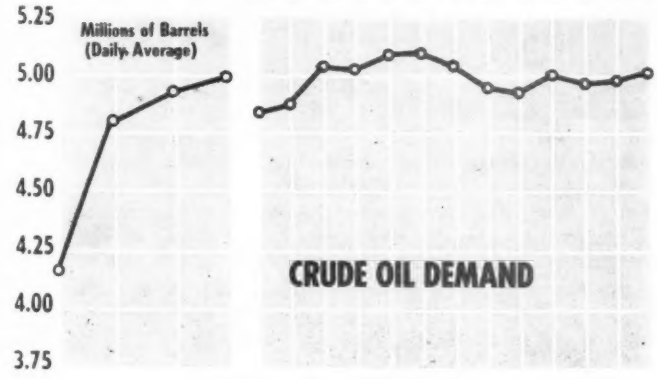
*Unless otherwise stated all figures represent thousands of barrels. ***Does not include input wells. (p) Preliminary. •Includes domestic production and imports.
‡Total demand, including exports. **Price 1926 (Index 100). △Includes finished and natural gasoline. §Includes service wells. ¶Revised.

Preliminary estimates based upon data furnished by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources

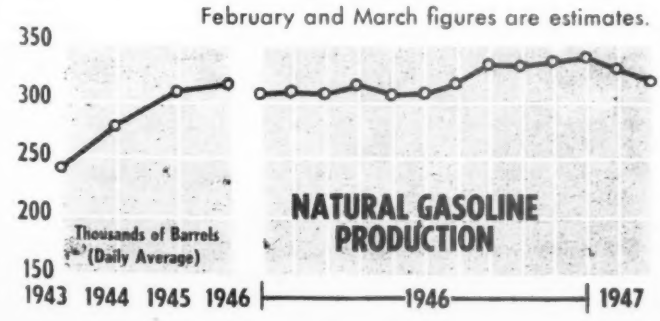


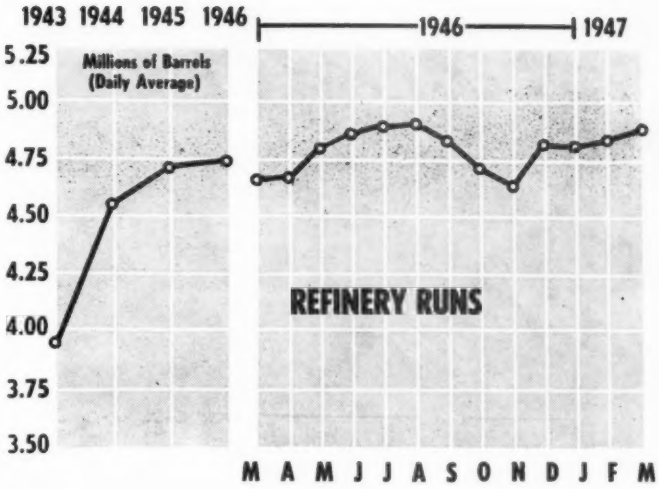


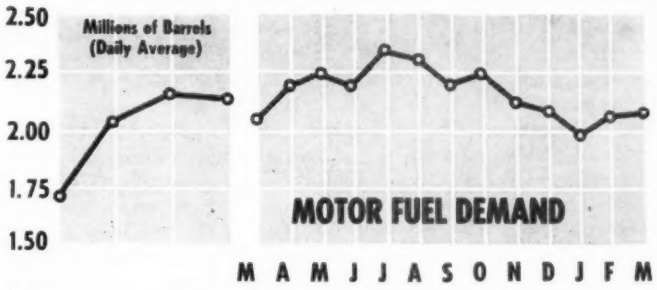


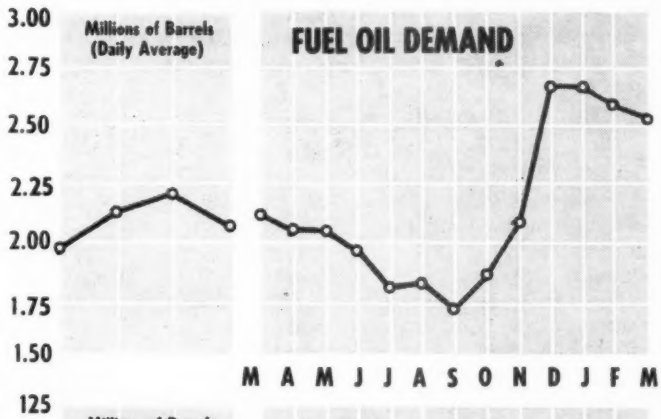


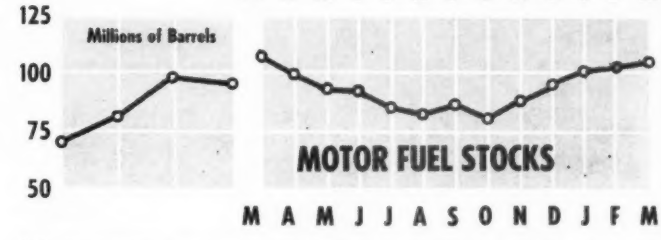
February and March figures are estimates.

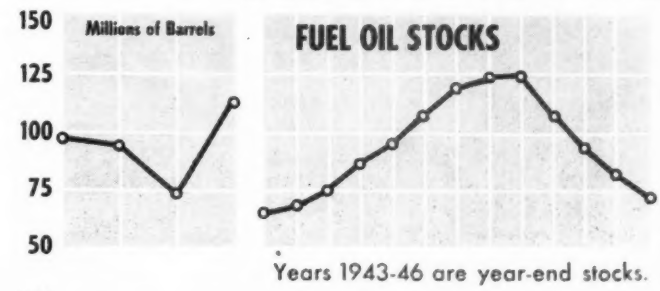




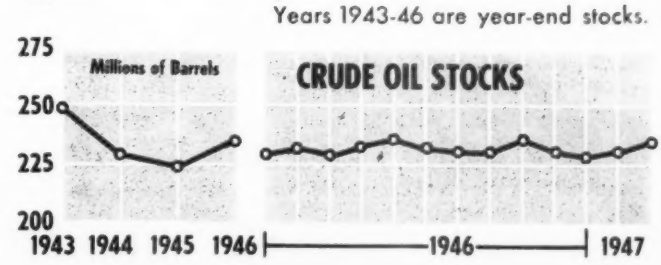




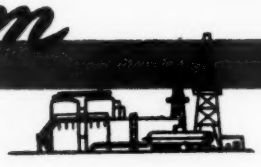




Years 1943-46 are year-end stocks.



highlights in oildom



● **PIPE SHORTAGE STUDY.** Steel pipe shortage, which has been hampering the natural gas industry for several years now, is scheduled to get more serious consideration by the federal government. The Interior Department's Oil and Gas Division interdepartmental advisory committee has announced the creation of a subcommittee to obtain data that can be used if the government decides to meet the threat of a continued shortage.

Although the situation has been critical for some time, both oil and gas operators are developing heavy construction programs calling for substantial quantities of large-diameter pipe. Because of this the advisory committee felt that it should have a complete picture of the supply and demand, particularly since natural gas shortages due to lack of facilities necessitated the closing down of some plants this winter and the picture for next winter does not now look too bright.

● **PUBLIC LAND LEASING REGULATIONS.** Regulations governing administration of federal mineral leasing act will be issued soon by U. S. Department of the Interior, according to Under Secretary Oscar L. Chapman. The new regulations will be designed to provide greater liberalization of leasing and to induce independent drillers to increase exploration of the public domain.

Regulations being made ready followed oil and gas industry protests to Congress in the last session that the present federal mineral leasing act prevents exploration of mineral reserves.

After the act was amended, over the protest of the Department of Interior concerning certain minor features, the bureau of land management called a series of conferences in the public land states to discuss proposed liberalization of regulations to implement the act.

Highlights to the amended regulations, intended to provide liberalization and clarification of the earlier regulations for the oil and gas industry include:

1. Although individual holdings may not exceed 15,360 acres, amended regulations will make it clear that an individual member of an association is chargeable only with his proportionate share of the total acreage held by the group.

2. Authority for oil and gas explorations on the public lands are procured through a series of options to use the land for that purpose, with a limit to 100,000 acres in any one state at any one time.

3. The Interior Department concurs with the oil industry that no acreage held under options taken prior to June 1, 1946, would be chargeable to the 100,000 limitation.

● **GAS WASTE CHARGED.** Independent Natural Gas Association has charged that considerable natural gas is going to waste because of Federal Power Commission regulations. Wesley E. Disney, general counsel of the association, said the regulations were discouraging the sale of gas by owners of gas-producing oil wells. These well owners, he said, "don't want to be declared natural gas companies and come under FPC regulations.

Disney and Russell R. Brown, general counsel of the Independent Petroleum Association of America, issued a joint statement endorsing pending legislation to prevent the FPC from regulating production, gathering or sales of gas.

● **NEW POOLS FOUND.** Twice as many new oil pools were found in Texas the first two months of this year as were reported for the same period of 1946. Operators reported 31 oil discovery wells to the Texas Railroad Commission, compared with 15 in January and February last year. Gas wildcats successful this year totaled nine, or three fewer than a year ago. Total gas well completions also were smaller, 98 compared with 136. Oil completions, however, were slightly higher, 742 last year and 766 this year. Drilling applications numbered 1527, up 257; whereas abandonments aggregated 965, an increase of 265 for the period. Most of the oil discoveries have been relatively small pools in West, North, and Central Texas but the wildcatting success has spread over most of the state.

● **TO INTENSIFY AUSTRALIAN OIL SEARCH.** Vacuum Oil Company, Pty., Ltd., a subsidiary of Standard-Vacuum Oil, together with Australian and British interests, is forming two new Australian companies to carry out an intensified search for oil and gas on the Australian continent, P. W. Parker, Standard-Vacuum chairman, has annonnced.

Vacuum Oil geologists, according to Parker, are unconvinced that earlier geological and geophysical work done by other oil companies in Australia has proved conclusively that oil in commercial quantities is not available on that continent. With the latest methods and equipment they plan to continue the search, he said.

Vacuum Oil, which will supervise the technical operations of the new exploration companies, will own a one-third interest in the organization. The other two-thirds will be divided equally between D'Arcy Exploration Company, a subsidiary of Anglo-Iranian, and Zinc Corporation, Ltd.

One of the new companies, the Frome-Broken Hill Company, Pty., Ltd., will begin immediately on comprehensive geological and geophysical surveys in South Australia, Queensland, and New South Wales.

The other new company, Bonaparte Gulf Company, Pty., Ltd., will investigate large unexplored areas in northern and western Australia.

● **STUDY STRIPPER WELL PROBLEMS.** Membership of a five-man committee to study the problem of obtaining maximum recovery of oil from the nation's stripper well reserves is announced by Hiram M. Dow, chairman of the Interstate Oil Compact Commission.

Don T. Andrus, Bradford, Pennsylvania, independent producer, was named chairman of the committee, and William J. Murray, Jr., Austin, Texas, petroleum engineer and member of the Texas Railroad Commission, was appointed vice chairman. Other members are: J. E. Berry, Smackover, Arkansas, independent producer, Ivan G. Burrell, Ohio Oil Company, Bridgeport, Illinois, and Charles B. Peters, Jr., Tulsa, Oklahoma, independent producer.

In announcing the appointments, Chairman Dow pointed out that principal purpose of the committee is to study the stripper well problems as they pertain to the necessity or advisability of governmental incentive or conservation payments, to make recommendations pertaining to such payments, and to make such other studies and recommendations on the problem of obtaining maximum recovery of oil from stripper wells as the committee itself deems advisable.

The committee was authorized at the Compact Commission's meeting in Dallas last December and is to work with such other agencies and organizations that are conducting similar investigations.

● **SAYS MEXICO SEEKING FINANCIAL AID.** Antonio J. Bermudez, Mexican Petroleum Administration (Pemex) director, said recently that Mexico is seeking financial backing to expand her oil development activities, and Labor Leader Vicente Lombardo Toledano implied that foreign oil companies are being asked to supply the funds.

Bermudez, speaking on the ninth anniversary of expropriation of foreign oil interests, said that Pemex has opened negotiations with unnamed parties for $15,000,000 to supplement its $4,800,000 budget for exploration and drilling. He did not comment on reports that foreign companies would be allowed to develop Mexican properties on a concession basis.

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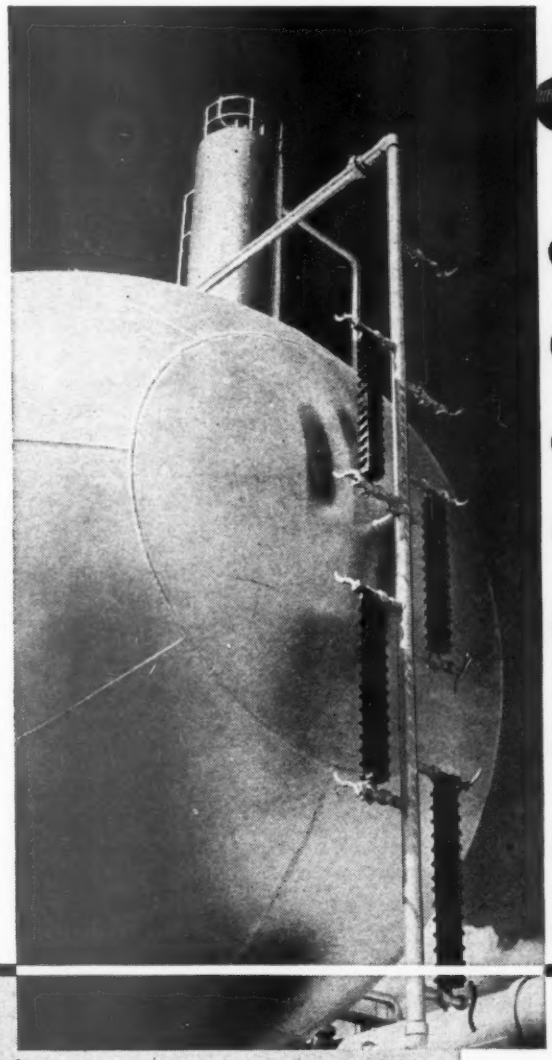

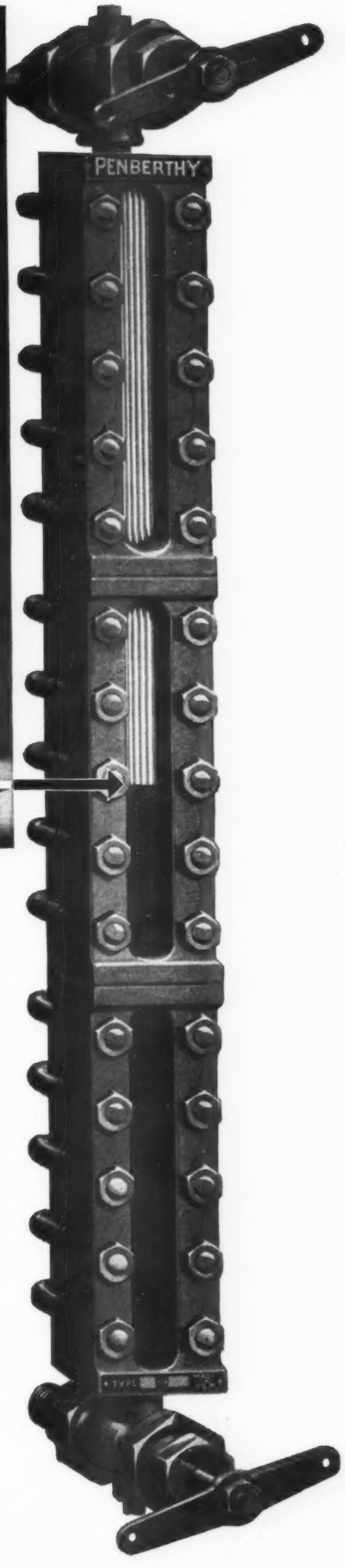

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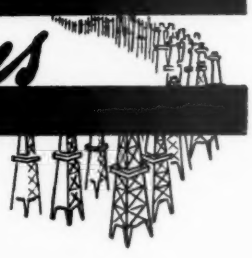


Exploration wells that have found production

● **LOUISIANA.** Texas 13 Delta Duck Club, 31-20s-20e, Plaquemines. Flowed 77* bbl 46.7° condensate 8678-714 ft. TD 9352.

Stanolind et al 1 T. S. Stegal, 21-9s-5w, Jefferson Davis. 28 bbl 44.8°, 2080 MCF from 6843-55 ft. TD 8233 ft. Completed.

Magnolia 1 C. Luther, 24-14s-11w, Cameron. Gas from 11,272-309 ft. Completed. 3400 lb pressure flowing.

Sohio 1 Chas. Richard, 1-15s-5w, Cameron. Logged gas 8250-86 and 8367-99 ft. Drilling to 11,000 ft.

Magnolia 1-C Lutcher, 24-14s-11w, Cameron. Gas and condensate from 11,272-309 ft. TD 11,705 ft.

Atlantic 1 Adeline Sugar Factory, 37-13s-9e, St. Mary. Flowed 110 bbl 34.2° from 7163-8 ft. New zone So. Jeanerette pool.

● **ARKANSAS.** Carter 1 Philyaw, C SW SE 36-16s-27w, Fouke field, Miller. 3 MMCF gas from 4940-4 and 4948-54 ft Kilpatrick, new zone. TD 7505 ft.

● **ILLINOIS.** Ralph Halbert 1 Price, SW NE SE 28-1n-2e, Marion. Pumped 8 bbl from 2123-38 ft, Rosiclare.

Illinois Mid-Cont. 1 Kurtz, NW NE SE 25-2s-14w, Wabash. Pumped 15 bbl oil, 15 water, from Tar Springs 2096-2118 ft.

National Association 1-A Jacobs, SE SW SW 24-6n-6e, Effingham. 118 bbl. TD 2866 ft.

J. W. Rudy 1 Hampton, SW NE NW 26-1s-5e, Wayne. Swabbed 195 bbl in 9 hr from McCloskey, 3154-62 ft. Pump.

● **KANSAS.** Phillips 2 Karst, NE SW SE 21-17s-14w, Carroll pool, Barton. Potential 356 bbl from Lansing-Kansas City lime, new zone.

Cities Service 3-B Pearson, NW SW SW 25-5s-20w, Ray pool, Phillips. Pumped 173 bbl from Lansing-Kansas City, new zone. TD 3571 ft.

Doley Oil 1 Moon, NW NW NE 24-13-21w, abandoned Riga pool, Trega. Potential 138 bbl Pennsylvania conglom. 3933 ft.

Phil-Han et al 1 Joe Veverka, SE SE SE 7-8-18w, Rooks. Est. 100 bbl oil from Arbuckle lime, 3405-13 ft.

Continental 1 Cotton, SE SE NW 14-12-21w, Trega. Drillstem, 120 ft oil from Arbuckle lime, 4960-92 ft.

● **TEXAS.** Gulf I-E-A University-Goodson, 7-35-U, Ector. Flowed 1032 bbl 41.6° from Ellenburger 8925-35 ft. Test.

Tobe Foster et al 1 Overcash est., 960-T F & L, Throckmorton. Flowed 128 bbl oil plus 3% water in 10 hr from 3936-41 ft.

Atlantic 1 McGill, first production in Kennedy County. Flowed 47 bbl 46.2° from 7676-80 ft. TD 9905 ft.

Cities Service 1 Riley, 361-G-CCSD & RGNG, Gaines. Flowed 15 bbl mostly oil in 2nd hr from Clearfork 7040-251 ft.

H. W. Snowden & Gas, 1 Turbeville, A-184 JBH, Archer. Flowed 116 bbl from 4620 ft. PB depth.

Warren 1 Cantrell, 2-SP, Jack. Flowed 547 bbl potential from Caddo, 4722-46 ft.

Coastal Refineries & W. D. Kennard 1 Coats & Vessels, Starr. Flowed 38 bbl 45.6° from 3870-82 ft. TD 4319 ft.

Fidelity Oil & Royalty 1 Edward Dietzel, Victoria. New zone 2959-61 ft. Flowed 83 bbl 21.3°. TD 4973 ft.

Warren 1 J. D. Gillespie "C", JBM sur, Jack. Pumped 20 bbl limestone 5515-20 ft. Completed.

Lloyd 2 Sally R. Donnell, JCS sur, Young. Flowed 32 bbl 40° in 8 hr 2328-40 ft. Completed.

Shell 2 Neuhaus, JWY sur, Lavaca. Flowed 131 bbl 46.2° from 5403-13 ft Cockfield. TD 8558 ft.

W. T. Graham 1 Campbell, BBB & C sur, Archer. Pumped 35 bbl 5052-92 ft. Completed after originally abandoned.

Stanolind 1 Kayser, 34-43-2s, T&P sur, Ector. Pumped 155 bbl new zone 8495-8565 ft Pennsylvania. TD 13,620 ft.

Coastal Refineries & Cook-Thompson 1 Zillah Hansen, McAllen field, Hidalgo, New zone 10 MMCF & condensate 10,090-180 ft. TD 11,101 ft.

Ellis A. Hall 1 J. D. Terrell, H&TC sur, Fisher. Flowed 307 bbl 40° limestone PB 4935 ft. TD 4942 ft.

Mosser & Quin 1 Chas. Muil, CCIC sur, Jim Wells. 15 bbl condensate 1.4 MMCF 5012-20 ft. TD 5517 ft. Completed.

Humble 7 King Ranch-Borregas, Borregas pool, Kleburg. 95 bbl 37° from 7076-81 ft new zone. Completed.

Gulf 1 University "R", 14-29-U, Crockett. Pumped and flowed 148 bbl 32.4° in 16 hr. Grayburg 1622. TD 1677 ft. Completed.

Fred Manning 1 A. W. Mueller, 2258-TE&L Stevens. Flowed 78 bbl from 3361-66 ft.

Shell 1 W. P. Wright, 5 mi SE La Gloria, Kleburg. 95 bbl 50.6° condensate, 6.4 MMCF from 9150-69 and 9195-207 ft.

Moore Exp. 1-4 A. C. Hoover "C", ACH sur, Crockett. Flowed 35 bbl 31° oil San Andres 2394. TD 2433 ft. Completed.

Cities Service 1-B Owen 6-GG-H&B, Crockett. Drillstem test 45 bbl 38° in 45 min, 600 MCF daily. Pennsylvania, 5601-70 ft.

Thomas Berry & Hill & Hill 1 D. C. Clayton, Bryson field, Jack. 25 bbl hr Mississippian 5140-50 ft. New zone.

E. Cockrell 5 Seaburn, Stratton Ridge pool, Brazoria. Flowed 130 bbl 29.2° from new zone 4565-86 ft.

Phillips 1 Atchison, JD-A-331 Cooke. Flowed 30 bbl 40° an hr from Ellenburger 2032-2064 ft.

Bluebird Investment 1 J. B. Pearson, JG sur. Anderson. Completed for 100 MMCF gas (est.), 400 bbl condensate from Woodbine 5503-18 ft.

Texana Petroleum 1 R. Lee Kempner, Clayton Harper, 209, Liberty. Completed 156 bbl 40.3° bbl from 5776-8 ft.

Grubb & Hawkins 1 Rudolph E. Peters, LC-16, Wharton. Reported 90 bbl 35° in 15 hr from 5100-14 ft.

S. Caprito 1 Compton-34-OAL, Caddo. Completed 127 bbl from 3431-41 ft.

● **MISSISSIPPI.** Texas Pacific Oil & Gas 2 Wilson, La Grange pool, Adams. New zone, 4625-42 ft Upper Wilcox. Drillstem 4600 ft 41.4°.

● **WYOMING.** Superior 1 Herrick, 1-16n-76w, Albany. 225 bbl in 15 hr from 3630-78 ft on Herrick Dome.

● **NEW MEXICO.** Texas 1 Garrett, C NE SE 22-16s-38e, Lea. Swabbed 49 bbl 30.6° in 8 hr from 5540-690 ft. Testing.

● **OKLAHOMA.** A. R. McElreath et al 1 Barnett, NW NE SW 24-3n-1w, Garvin. Drillstem 20 bbl 42° an hr, 2.5 MMCF a day from 4050-7 ft, Simpson.

H. F. Gibson 1 Smith, NW NW SW 14-5s-1w, Carter. Flowed 105 bbl in 10 hr from 4134-48 ft. TD 4566 ft. To complete.

Davon Oil 1 Charles Mee, NE NE SW 16-8n-7e, Seminole. Flowed 15 bbl in hr, 2.5 MMCF gas per day. New zone 3260-2 ft, Cromwell.

Globe O&R & Vickers Pet. 1 Carr Community, SW Antiock pool. Tested 30 bbl an hr from Bromide 7358-91 ft. New zone.

T N. Berry 1 Palmer, SW SW SW 11-12-8e, Okfuskee. Drillstem 3250 ft oil in 1 hr from 3750-61 ft Cromwell sand.

Goodner & Wharton 1 W. T. Holland, SW SE NW 28-23n-15e, Rogers. 150 ft oil in hole. Mississippi lime topped 1120 ft.

Atkin-Dimock 1 Shaw, SE NW NE 28-3s-11w, Cotton. Pumped 70 bbl 35° from 1518-25 ft. Completed.

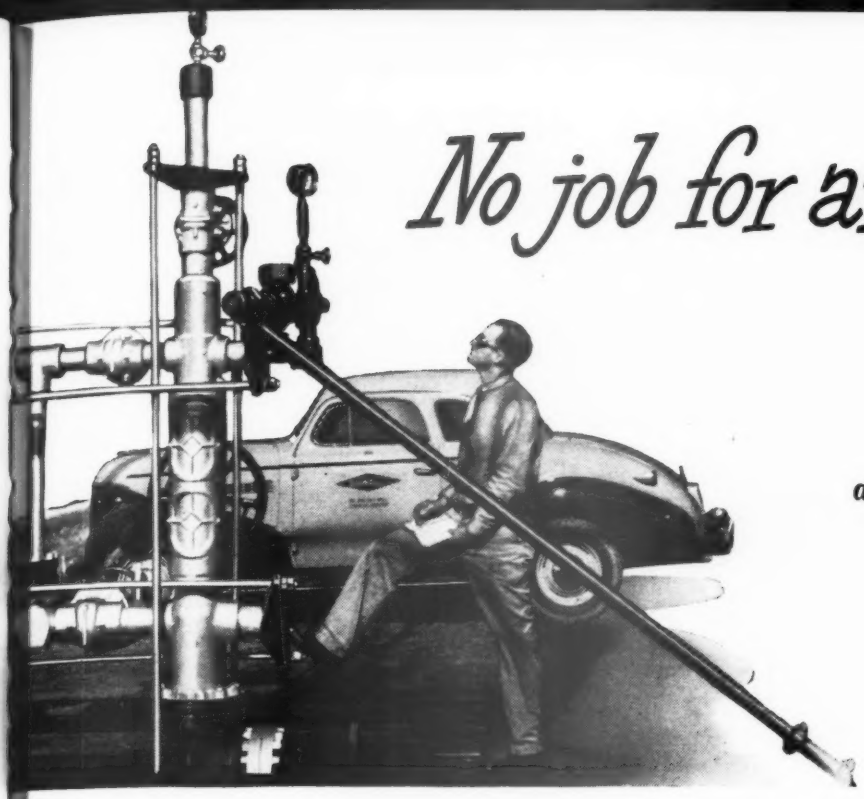
J. W. Baldwin et al 1 Shaw, SW NE NE 28-3s-11w, Cotton. 50 bbl 35° from 1513-25 ft. TD 1527 ft.

Oil Carriers 1 Martin, NE NE 1-4n-4w, Garvin. Flowed 374 bbl 42° from Chimney Hill 8585-720 ft and 9060-100 ft.

Lotus-Trogan 1 Feitz, NE NE SE 27-14-19w, Ellis. Potential 132 bbl Arbuckle 3712-8 ft.

● **KENTUCKY.** Pure and Stanolind 1 Hammons, 22-L-67, Clay. High gravity oil swabbed from 3700 PB 4000 ft TD.

*Production figures for day unless specified otherwise.



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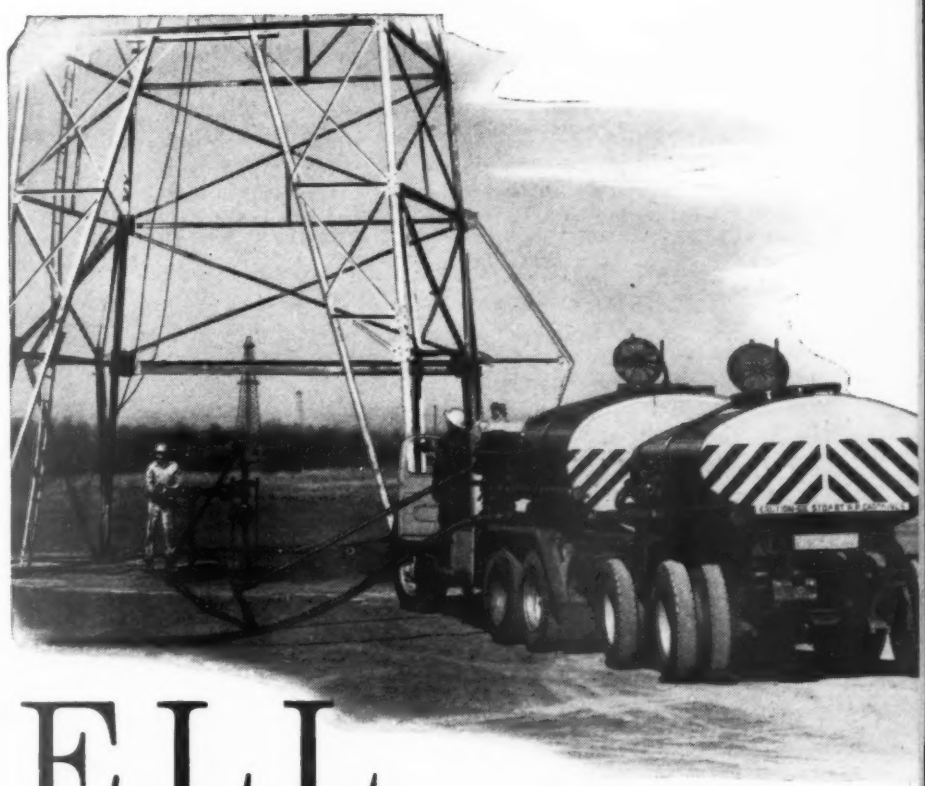

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pipeline developments

● **PLANS 3000 MILES OF LINES.** Harry F. Sinclair, president of Sinclair Oil Corporation and the Sinclair Refining Company, has announced plans for construction of more than 3000 miles of petroleum products pipelines. The projected carriers will connect with existing lines of the company to connect Atlantic coast, Gulf and Great Lakes refineries in a co-ordinated system serving the most important consuming areas if the country, Sinclair said.

A 10-in. line will start from the Houston refinery on the ship channel and extend northward to Fort Worth, Tulsa, Coffeyville, Kansas, and Kansas City, he disclosed.

From Kansas City an 8-in. line will be laid eastward to St. Louis across Missouri, southern Illinois and Indiana, connecting at Columbus, Ohio, with the Ohio Products Pipe Line System. Consumer points to be served by this line include Terre Haute and Indianapolis, Ind., and Dayton, Ohio.

● **EXPANSION SCHEDULED BY UNITED.** FPC has application by United Gas Pipe Line Company, Shreveport, Louisiana, to construct about 93 miles of 18-in. pipe line extending from the Baxterville gas field in Marion County, Mississippi, to a connection with the company's line near Mobile, Alabama. Permission was also requested to replace about 8½ miles of 12-in. pipe on the Mobile-Pensacola main line with 16-in. pipe and to loop a 6-in. tap line extending from the Mobile-Pensacola line to the Florida Pulp and Paper Company near Cantonment, Florida, with about 3½ miles of 8-in. pipe. Cost of the facilities has been estimated at $3,150,000.

Total gas reserves in the Baxterville field are estimated at approximately 250 billion cubic feet and a contract with Gulf Refining Company assures coverage of 150 billion cubic feet, the company stated. The company estimated the 18-in. line from the Baxterville field will have a maximum capacity of approximately 77 MMCF per day. The new 16-in. loop line will increase the capacity of the Mobile-Pensacola line from 26 MMCF per day.

● **THE DAVIES' NEW FIRM PROPOSES LINE.** The Truckline Gas Supply Company has requested authority from FPC to construct and operate a 30-in. natural gas transmission pipe line extending from Wharton County, Texas, through Arkansas and Missouri to Keokuk, Iowa, a distance of about 855 miles. Cost has been estimated at $74,266,507. The company plans to commence construction as soon as materials become available and estimates that the facilities would then be installed within a year. The Trunkline is a newly formed company and is incorporated in the State of Delaware. Its president is Ralph K. Davies.

Although the company has not finally contracted for specific reserves of gas, it stated that the Gulf coastal gas fields have estimated proven gas reserves of over 43 trillion cubic feet, only a relatively small proportion of which has been committed to pipe line or industrial users and, in addition, large quantities of flare gas being wasted in the area.

● **CRUDE LINES FROM WEST TEXAS.** Plans for three projects have been announced to increase the outlet of crude from the West Texas Permian Basin, where production now is being held to pipe line capacity.

Stanolind Pipe Line Company has let contracts for 6-in. feeder lines to the Petersburg, Irish, and Anton fields. Outlet from the Petersburg field will tie into the Stanolind's trunk between Hockley county and Drumright, Oklahoma.

Gulf Refining Pipe Line Division of Gulf Oil Corporation, is to construct 105 miles of 8-in. and 10-in. loops in its system from Midland to Lufkin, increasing capacity to a total of 120,000 bbl daily, 10,000 bbl more than at present. Work is to start early in April.

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● **THREE COMPANIES SHARE BIG LINE.** Empire Pipeline Company, subsidiary of Cities Service Oil Company, plans to share in the ownership of the projected 500-mile crude oil pipe line with the Texas Pipe Line Company and Shell Pipe Line Corporation, according to an announcement by A. W. Ambrose, president of Empire Pipeline and Cities Service Oil Companies.

Plans for construction of the big carrier were revealed last month. The present plan is for the line to be jointly owned, with Texas Pipe Line Company owning 53 per cent, Shell Pipe Line Corporation 33⅓ per cent, and Empire Pipeline Company 13⅔ per cent. Route of the 20 to 24-in. line extends 500 miles from Jal, New Mexico, via Midland, Westbrook and Wichita Falls, Texas, to Cushing, Oklahoma.

● **1000-MILE GAS LINE PROSPECT.** Plans for a 1000-mile, $55,000,000 gas line from the Houston area to West Virginia were outlined by President Gardiner Symonds of Tennessee Gas and Transmission Company in his annual report to stockholders.

Construction will begin as soon as authority is granted by the Federal Power Commission and materials are available, Symonds said. Application for a permit is now before FPC.

The company now has a 1385-mile gas line from Brownsville to West Virginia, with capacity of 290 MMCF daily. Under construction are additional facilities to increase the capacity of this 24-in. line to 381 MMCF daily. The proposed 26-in. line parallel to the existing line will increase the daily capacity to 600 MMCF daily, Symonds said.

● **PANHANDLE EASTERN PLANS ADDITIONS.** Panhandle Eastern Pipe Line Company has filed an application with the Federal Power Commission requesting authorization to construct and operate additional pipe-line facilities in Texas, Kansas, Missouri, Illinois, Indiana and Michigan. The facilities are to be added to the Group A and B facilities recently authorized by the FPC and are estimated to cost approximately $23,464,000.

Designed to raise the applicant's system peak-day capacity approximately from 473,000,000 cu ft to 580,000,000 cu ft per day, the facilities proposed include construction of about 356 miles of 26-in. pipe as a third loop line and installation of an aggregate of 37,600 hp in existing compressor stations.

The "A" facilities authorized by the Commission in June 1946 have now been completed and are in operation, the application stated, and construction of the Group B facilities authorized in November, 1946 will be commenced as soon as the necessary pipe and appurtenant equipment is available.

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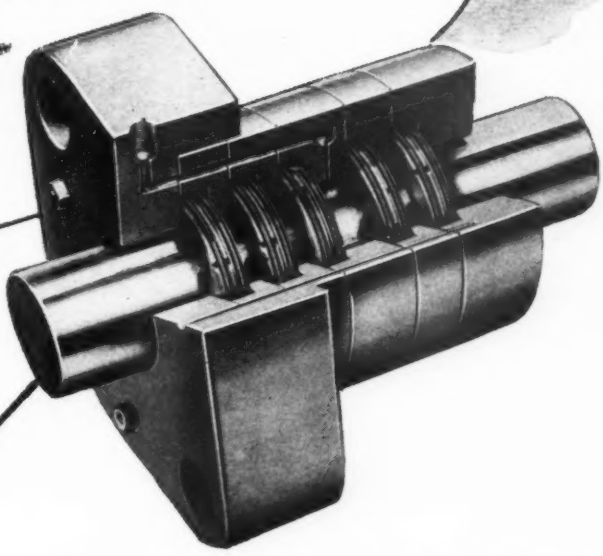

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As a result, Cook Packing is the accepted standard in many industries and is being used as original equipment in most severe service units building today where dependability really counts. So, when you order new equipment, remember there is no substitute for experience. Be sure to specify Cook Packing. For existing equipment, write us direct.

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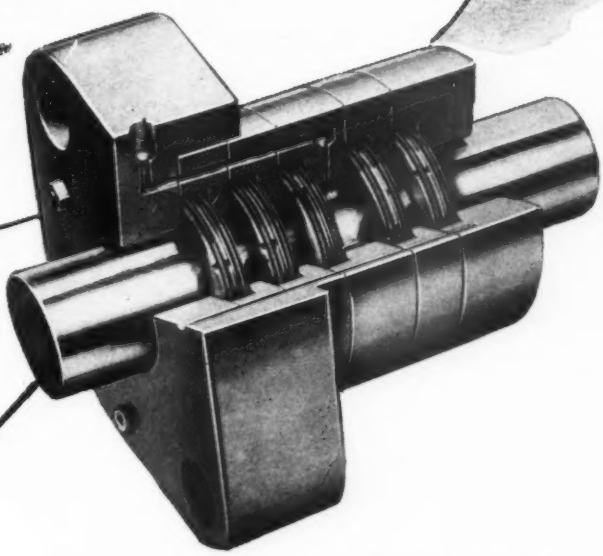

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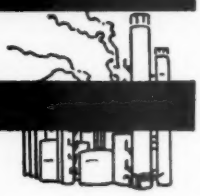
refining and natural gasoline activities



● **NEW HUMBLE GASOLINE PLANT.** Construction has started on the Tom O'Connor natural gasoline plant some 15 miles northeast of Refugio, Texas. The plant is being built jointly by Humble Oil and Refining Company and Quintana Gas Company at a cost of approximately $3,000,000. The plant is scheduled for completion late this fall.

Plans call for the installation of stripping equipment to handle a maximum of 35 MMCF of casinghead gas a day and compression equipment for between 25 and 30 MMCF a day.

Humble and Quintana officials in a joint announcement stated that casinghead gas would be taken not only from wells operated by the two companies in the big Tom O'Connor oil field, but from every one of the more than 500 active wells. Current oil production in the prolific field is in excess of 40,000 bbl a day; casinghead gas which lifts this oil to the surface is produced at the rate of 23 to 25 MMCF a day.

The Tom O'Connor plant is the third in the Gulf Coast area which Humble has under construction either as sole owner or as joint owner with others. A somewhat larger natural gasoline plant is nearing completion at Clear Lake, between Houston and Galveston, and one of approximately the same size is under construction at Anahuac. The total investment by Humble in these casinghead plants for the conservation of gas will approximate $10,000,000, a company official said.

● **TCC UNIT BUILT IN FIVE MONTHS.** First postwar small-scale catalytic cracking plant was erected at Alma, Michigan, for Leonard Refineries, Inc., by Catalytic Construction Company, subsidiary of Houdry Process Corporation. It has 3000 bbl a day capacity. Contract was awarded April 1, 1946; ground was broken September 10; and the first small-scale thermofor catalytic cracking unit was completed in less than five months.

T. Ellwood Webster, president of Catalytic Construction Company and vice president of Houdry Process Corporation, attributed a large part of the speed on the construction job to the company's purchasing and expediting departments.

The Leonard TCC unit is compact in design, with the over-all height substantially reduced and the structure considerably simplified.

● **GAS-PROCESS UNIT IN DELHI.** Joseph L. McHugh, commissioner of conservation, recently announced plans of the Sun Oil Company and C. H. Murphy, Jr., to construct a $2,500,000 liquid hydrocarbon extraction plant in the Delhi, Louisiana, field to process some 14,500 MCF of gas daily.

The plant, McHugh estimated, will reduce the amount of gas flared (burned) to about 200 MMCF daily. Earlier it had been cut in half from a total of more than 550 MMCF, and expected developments will reduce it still further to about 150 MMCF this year. Construction already has begun on the plant, which will be built about two miles west of Delhi.

● **VACUUM FLASHER IN WORK.** Construction has started on a large new vacuum flashing unit at the Shell Oil Company's Wood River, Illinois, refinery, H. D. Dale, manager of the refinery, has announced. The new unit, the first major construction undertaken at the refinery since the war, will supply additional feed stock for the refinery's twin catalytic cracking plants.

The vacuum flasher will process 35,000 bbl of topped crude oil daily, when completed, according to Dale. Crude oil will flow to it from topping plants, after it has passed through the initial distillation processes, and the flasher will separate the topped crude into light and heavy fractoins. Light fractions will be fed to the cat crackers for the production of motor gasoline, fuel oils, and raw materials for aviation gasoline manufacture, and heavy fractions will be used as a base stock for asphalts.

The plant is expected to be in operation during the latter part of the year. The C. F. Braun Company of Alhambra, California, has contract for engineering and construction.

● **RANGELY TO HAVE GAS PLANT.** Stanolind Oil and Gas Company and The California Company, major operators in the Rangely field of Rio Blanco county, Colorado, have let contract for construction of a $4,000,000 casinghead gasoline plant in the field. Gas produced with oil will be processed at the plant and it is expected initial yields will average between 10,000 and 20,000 gal daily. Contract for the plant was let to the Hudson Engineering Company, of Houston, Texas. Work will start as soon as materials and men can be made available.

The Rangely field now has 279 producing oil wells with a total production of 25,131 bbl a day. There are 41 tests drilling in the field which, so far, has had only one dry hole.

● **HUGE COAL PROCESSING UNIT PLANNED.** The Pittsburgh Consolidation Coal Company and Standard Oil Development Company have announced plans to build a new industry in which soft coal can be turned into gasoline, diesel oil, and fuel gas. The revolutionary multi-million dollar program would assure the nation of a source for synthetic gasoline that would last more than 5000 years, it was said.

By 1951 the project is expected to have a unit operating for gasification and liquefication of coal to be built at a cost of over $120,000,000. The plant would assure Pittsburgh industries an adequate supply of fuel gas in winter, and could produce gasoline for motorists in summer.

● **PLANTS SOLD.** Units that have changed ownership during March include:

Rock Island Refining Corporation, Indianapolis, Indiana, purchased the Onyx Refining Company of Abilene, Texas. The properties include a refinery, pipe line gathering system, headquarters, and bulk distribution system. L. B. Simmons, president, sold Rock Island properties at Duncan, Oklahoma, last year to Wood River Oil and Refining Company. The Indianapolis unit operates on crude from the Illinois basin.

The Co-operative Refinery Association has bought a 100-octane plant at Coffeyville, Kansas, from War Assets Administration for $1,200,000. The plant cost $4,656,804 and present value was set at $1,375,000. The Co-operative was wartime operator of the unit.

Continental Oil Company was the only bidder for a government refinery at Ponca City, Oklahoma, it was announced by WAA. The bid was $3,034.040.03 for a part of the unit that had been assessed at $8,000,000. It was operated by Continental during the war.

Frontier Refining Company was the only bidder for a gasoline plant in Cheyenne, Wyoming, which it operated in wartime, according to a WAA release. The bid was for $1,-994,300 with stipulation that $700,000 be deducted for improvement. Cost of the project was said to be $7,892,000.

THE Petroleum Engineer

April, 1947

Cycling plant important to Rincon field

By **FRANK H. LOVE,** *Managing Editor*

DEEP in South Texas, in Starr County to be exact, is the Rincon field, one of the great natural petroleum reserves of the area. The field has a total of 161 wells, 134 of which produce crude oil, six gas, five are used for gas injection, and 16 are temporarily shut down pending recompletion. The field has 13 named sands from which oil and gas may be produced, all being of the Lower Frio and Upper Vicksburg formations. Producing depths are from 3450 to 4800 ft.

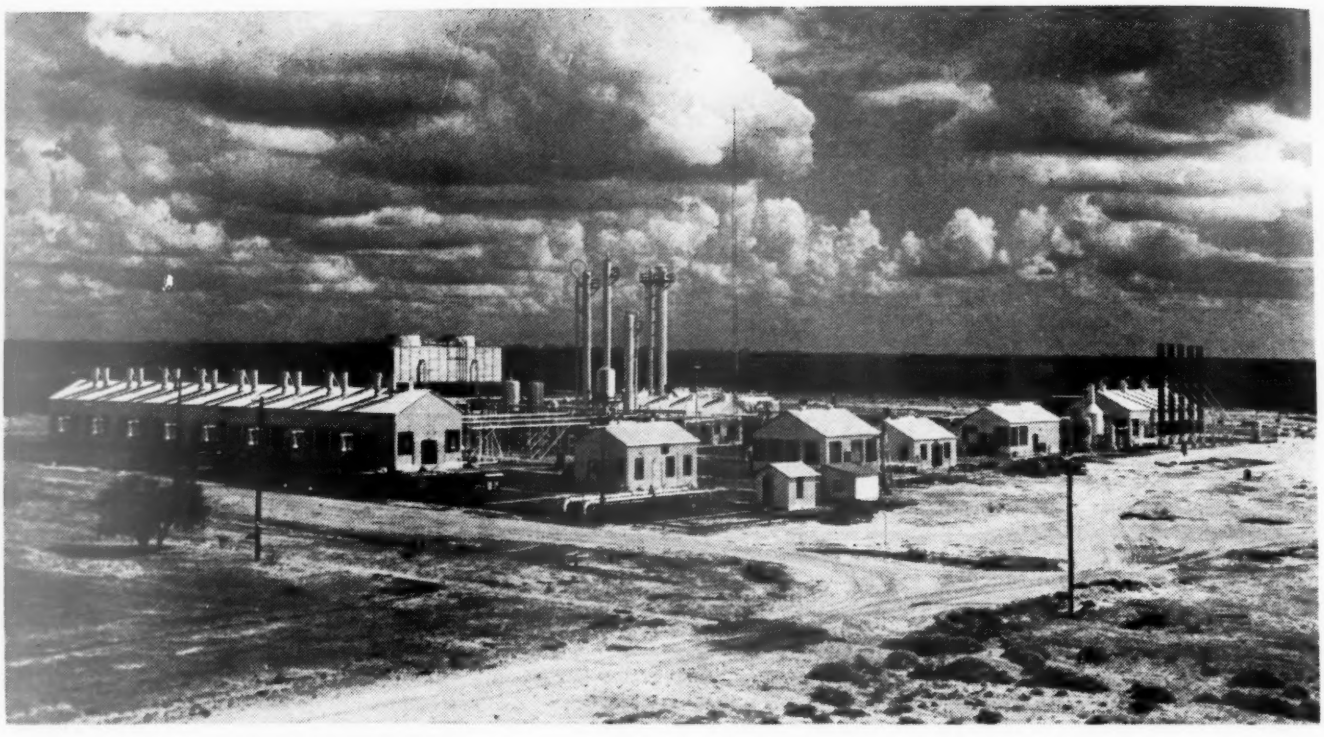
EXCLUSIVE

The Rincon field has an interesting history. Named for the Rincon Ranch, on which it is situated, the territory originally was a desolate wasteland of sand and mesquite, inhabited principally by coyotes, lions, javelinas, and the diamond-back rattlesnake. The only cattle that could subsist on its barren soil was the hardy Brahma.

The first oil test made in the area was by the Danciger Company in 1927. The test was abandoned at 3701 ft. Two years later the lease on the ranch was sold to T. B. Slick, the famous wildcatter, who drilled four dry holes. Transwestern Oil Company, who took over in 1937, brought in a gas-condensate producer on its fifth try, then drilled five more dry holes. In 1939, W. R. Davis purchased the lease from Transwestern and contracted for the drilling of ten wells. From this resulted the bringing in of one high gas-oil ratio well and a gas well. What is now called the discovery well of the Rincon field, however, was the Slick B-528 No. 6, completed January 1, 1940. This was the seventeenth test to be put down on the Rincon Ranch. The discovery well was completed at a depth of 4866 ft and produced 119 bbl a day of 46-gravity crude oil. This led to an active drilling campaign and during the next 11 months 50 wells were drilled.

Continental Oil Company came into the picture November 1, 1940, when it bought a half interest in the field from

Continental's beautiful camp is an oasis in barren South Texas area.



Continental Oil Company's plant has its setting amid 20-ft high mesquite.

W. R. Davis and assumed complete management. Rice Institute of Houston, Texas, purchased the other half of the property a year later as an investment.

One of the important accessories in the field is the natural gasoline and pressure-maintenance plant, constructed by Continental. Prior to November, 1945, the plant was utilized principally for pressure maintenance, although some condensate was recovered from the gas before it was returned to the producing formations. Within recent months, however, five compressors have been added to the original three, and absorption gasoline recovery and fractionating equipment has been provided. The plant now produces approximately 18,500 gal. of 20-lb RVP natural gasoline and 1500 gal of 82-lb LPG, in addition to returning about 8,000,000 cu ft of dry gas a day to the producing sands. The liquefied petroleum gas is trucked out and used for commercial purposes in the Rio Grande Valley. The natural gasoline is pumped through a pipe line to a railroad loading rack 15 miles south of the field.

Through a network of field lines casinghead gas is received at the plant at vacuum pressure. The incoming gas passes through a scrubber ahead of each stage of compression. The eight 600-hp angle type compressor units compress the gas in four stages from vacuum to 2000 psi for injection into key wells. After each stage of compression the gas temperature is reduced in an interstage cooler. After the third stage of compression, when the gas pressure is 500 psi, the gas enters the absorber where it is contacted by lean absorption oil. The dry gas is delivered to the suction of the fourth stage compressors and discharged to injection wells at 2000 psi. The rich oil from the absorber is pumped to a stabilizer. The overhead vapors from the stabilizer are used as fuel. Bottoms pass through a heat exchanger and preheater into a flash tank. Flash vapors are discharged back through the stabilizer and the rich oil goes to the still. After the hydrocarbon content has been stripped from the rich oil in the still, the lean oil is pumped through the rich oil heat exchanger, a cooler, filter, into a surge tank, and back to the absorber.

Still overhead passes through a condenser to a reflux tank. A part of the stream is refluxed back to the still, the rest being charged through heat exchangers into the gasoline stabilizer. From the stabilizer column natural gasoline passes through heat exchangers to storage. The stabilizer overhead goes through condensers into a reflux tank, a part of the stream being refluxed back to the gasoline stabilizer, the rest being charged into the liquefied petroleum gas stabilizer. The bottoms from this column are discharged through heat exchangers and coolers into the LPG storage. The overhead goes through condensers and into a reflux tank, the reflux being charged back into the stabilizing column.

Injection into key wells, at the aforementioned pressure of 2000 psi, is through the well tubing. Of the five key wells, one is temporarily shut down and four are active. Three other injection wells are in the process of being cemented up.

Continental Oil Company's camp in the Rincon field, which houses the operating personnel of all departments, is truly an oasis in this South Texas desert. The population of this village of 100 persons lives in 32 modern cottages arranged on three streets. Palm and citrus trees provide shade. A grocery store, cafe, airport, fire department, filling station, and garage, are all a part of the village's conveniences. Each morning 38 children are taken by bus to school in Rio Grande. For the children too young to go to school a park is provided, protected by fine-mesh wire snake fence.

Although the Rincon field has been mentioned as being a desert and desolate wasteland, some of these things are of the past. Today Rincon is not as isolated as in the beginning, A new highway is being constructed six miles to the west, and roads leading to the field have been drained and graded. In the field itself, a network of about 80 miles of lease roads connects the camp, gasoline plant, and derricks, to each other and to the main highway.

● **Contractor.** Contractor for construction of the gasoline plant was Jones and Laughlin Supply Company.

Typical sample of gas processed at plant:

Component	*Mol. per cent*
Methane	82.35
Ethane	6.94
Propane	3.55
Isobutane	1.58
N-butane	1.41
Isopentane	1.00
N-pentane	0.58
Hexanes plus	1.60

★ ★ ★

Novel groundbed for cathodic protection

By **TOM R. STATHAM,** *Engineer,* Magnolia Pipe Line Company

EXCLUSIVE

DURING the ten-year period from 1933 through 1942, 73 leaks had occurred on the Magnolia Pipe Line Company's three 8-in. and one 10-in. pipe lines in the first four miles south of its Corsicana station. These lines pass through the watershed of the Corsicana City Lake—the water supply for the City of Corsicana, Texas. These lines were from 14 to 30 years old. The last one laid was placed in operation in 1928. All the 8-in. lines were screw lines and the 10-in. line was welded. Various spot reconditioning had occurred, but two of the 8-in. lines were completely reconditioned in 1935-36, and most of the collars welded. The 10-in. line was partly reconditioned in 1938. A grease coating with a spiral rag wrapper was hand-applied to the two 8-in. lines when they were reconditioned. A hot wax-asphalt mixture with a spiral asbestos wrapper was machine applied to the 10-in. line when it was reconditioned. On contact at leaks, all these coating materials were softened or dissolved by the product being handled through the line. By the fall of 1941, leaks were beginning to recur with increasing frequency in this area. By that time most materials had been declared critical and priorities were required for their procurement.

Considerable work had been done in the past to determine the corrosiveness of the soil in this area, i.e., soil resistance measurements at regular intervals (Shepard Canes), pH of the soil at regular intervals, and a classification of the soil. These data are shown in Fig. 1. Other data available for study, but not shown in Fig. 1, included a saturated specific resistance measurement, and results from "Corfield Nipple Tests" run on soil samples taken from this area. Additional data were needed, so it was decided to take pipe-to-soil potentials (using the copper sulphate electrode), long line current measurements, and to "Megger" the soil at regular intervals for resistance measurements at 5 and 10-ft depths. These data are in Fig. 1.

It was decided, because of the extremely corrosive area through which the pipe lines passed and because the resistance afforded by any remaining coatings on the lines was considered as practically negligible, to install a system of continuous cathodic protection throughout this area. Also, due to the difficulties of obtaining the necessary materials, and the critical needs of our Armed Forces, it was decided to make the greatest possible use of all class two and three materials on hand, as well as junk. By this time, several junk drives had been completed by the government, and the amount of junk available for this work was quite short; however, there did exist sizeable quantities of drill cable in fair metallic shape, but which was damaged to such an extent that it was unsafe for use as drill cable. Copper cable was extremely short, and all used copper cable on hand had been earmarked for other work. It was decided to utilize the drill cable to the greatest possible extent. It was decided also to try to hand-insulate this bare steel drill cable for use as connections (underground) from the rectifiers to the pipe lines and to the groundbed.

In line with these ideas, and to conserve scarce materials and power, it was decided to install a groundbed different from the conventional type; a groundbed that would best utilize these scarce materials, and also afford a more uniform distribution of current throughout the extent of the protected area. A ditch, 4 to 5 ft deep, was dug parallel to and at a minimum of 250 ft away from the pipe lines. Two drill cables (1⅛ or 1¼ in.), which had been doped with a high insulating material, were placed in this ditch, which was some four miles in length. Twenty-foot joints of pipe were welded to the drill cables. The location of these joints of pipe is shown on the groundbed detail of Fig. 2. The spacing of the pieces of junk pipe was determined by soil resistance measurements made as the ditch was dug. It was thought that this type of groundbed would decrease the current density usually prevalent in the vicinity of the rectifier, and increase the current density between rectifiers. Thus a more efficiently operating installation would result, an installation that would get the maximum protection from the minimum power, and would in turn give longer life to the groundbed. The weakest link in this set-

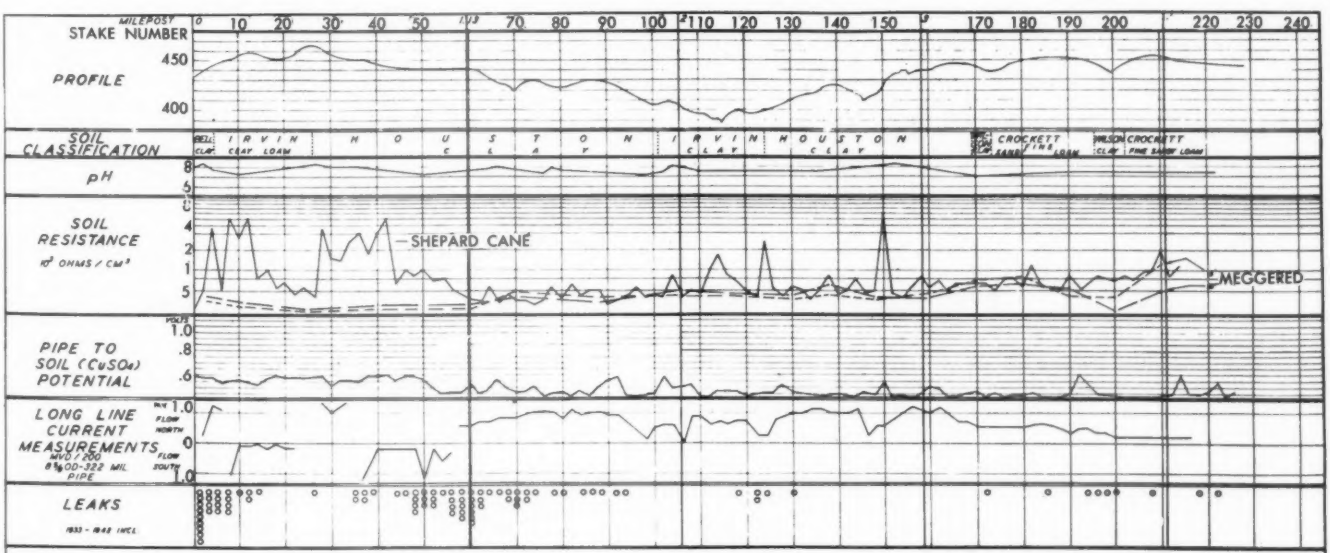


FIG. 1. Corrosion and engineering data accumulated prior to cathodic protection construction.

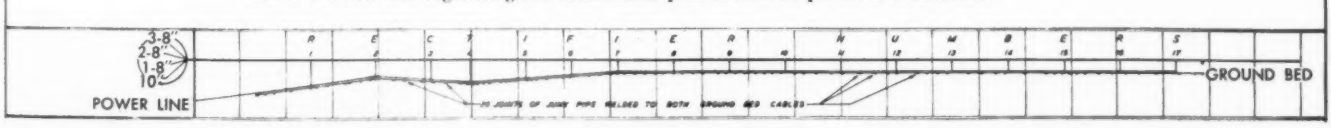


FIG. 2. Plat showing spacing of rectifiers and ground bed detail.

up was recognized to be the hand-insulated lateral connections—the connections from the rectifiers to the pipe lines and groundbed. It was planned to replace these connections when materials became more plentiful.

Rectifiers of 8-volt 20-amp were purchased. These were equipped with selenium stacks, and their transformers were supplied with taps at 1-volt intervals from 1 to 12 volts. The spacing of the 17 rectifiers is shown in Fig. 2.

A power line was built south from the transformer bank at Corsicana station, a distance of 4 miles.

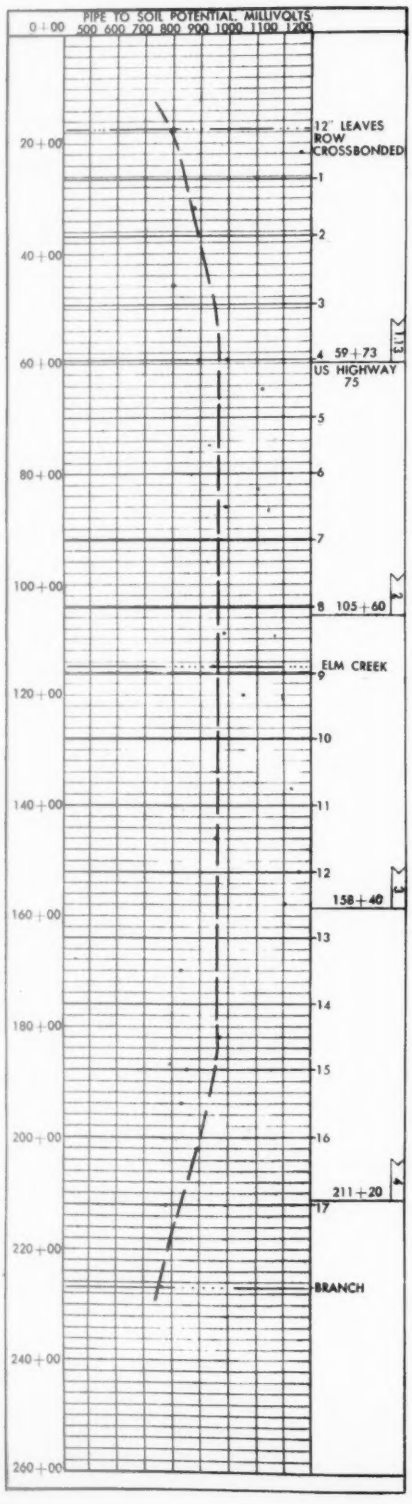
This installation was completed and placed in operation in March, 1942. As initially set, the total output was 229 amp, but the rectifier outputs were readjusted downward to 208 amp, or an overall average of 1.03 milliamperes per sq ft of pipe surface. One rust hole occurred within the protected area shortly after the cathodic protection installation was completed, but since then there has not occurred a single leak that could be attributed to corrosion. During all the war years when manpower and materials were scarce, this installation operated efficiently with a minimum of maintenance.

Soon after the writer returned from the Armed Forces, in midsummer of 1946, it was deemed advisable to investigate the effectiveness of this installation, and also to determine so far as possible the condition of the groundbed and all electrical connections. In the meantime, materials were becoming available again, and good copper cable with insulation that would give long service in underground use was found in local stocks. In our warehouse there were several thousand feet of used "Reda" cable no longer suitable for use as such, but suitable for our use. Also, an adequate quantity of junk pipe had become available to supplement the existing groundbed.

A quick investigation revealed that the output of the rectifiers had fallen off to some extent. Further investigation revealed that there had begun to be some leakage of currents through the hand-insulated cables at some places. At one location the groundbed cables were in poor condition and at another they had been cut in two and never patched.

It was therefore decided to replace the hand-insulated lateral connections (which had deteriorated to some extent), with good, adequately insulated copper cables, and that while the excavation necessary to increase the tonnage in our groundbeds was partially done, to utilize the scrap pipe available for this purpose and thus add many years to the life of our groundbed. This work was completed, and the rectifiers set so that their output would afford a current density of 1 milliampere per sq ft of pipe surface. After the rectifiers had operated at that output for several weeks, tests were made to determine the effective protection being received. The rectifiers were re-set at a lowered output, or a total of 171.5 amp, which gave an average current density of 0.72 milliamperes per sq ft of pipe surface. In Fig. 3, the pipe-to-soil potential measurements are shown as small circles, the heavy numbered lines indicate the location of the rectifiers. The curve drawn shows the average pipe-to-soil potential curve. The criterion normally accepted by corrosion engineers as a measure of full protection is 850 mv pipe-to-soil potential, with potentials below 850 and above the electrode potential affording at least partial protection. ★ ★ ★

FIG. 3. Pipe to soil potential measurements.



Rules on how to determine distance between oil machinery shaft centers

In connection with oil machinery belt drives a belt user recently asked for a special belt drive rule. He wrote:

"It is easy enough to get the distance between centers of two pulleys in actual practice, but can you tell me how to obtain this figure when I know the length of the belt, or the distance around the pulleys, and the diameter of both pulleys, but do not know the distance between centers.

"I am trying to get hold of a rule that can be worked by common arithmetic. I can do it by algebra, but I wonder if you have any rule of can dope one out that could be used by a man who does not know algebra."

Here are two rules that this writer worked out for him:

● **Pulleys unequal.** When there is considerable difference in the diameters of the pulleys apply this rule, which may be called "Rule No. 1":

All measurements are in inches.

1—Square the length of belt.

2—Multiply the square of the sum of the pulley radii by 9.87.

3—Add (1) and (2).

4—Multiply the sum of the pulley radii by the length of the belt and then by 6.28.

5—Multiply the square of the difference of the pulley radii by 4.

6—Add (4) and (5).

7—Subtract (6) from (3) and extract the square root of the difference.

8—Divide by two.

This gives the distance between shaft centers in inches.

● **Pulleys equal.** The following which may be called "Rule No. 2," is much simpler than Rule No. 1, but it is intended only for pulleys that are equal or nearly equal in diameter. It is accurate for pulleys that are equal in diameter, but as the difference increases it becomes more and more inaccurate.

All measurements are in inches.

1. Add the radii and multiply by 3.14.
2. Subtract from length of belt.
3. Divide by two.

This gives the distance between shaft centers in inches when the pulleys are equal or nearly equal in diameter.

● **For V-belts.** The above rules apply to V-belt drives as well as to flat belt drives. To find the radius of a V-belt sheave, divide the pitch diameter of the sheave by two. ★ ★ ★

Evaluating cooling tower performance

By **JAMES G. DE FLON,*** The Flour Corporation, Ltd.

● **Principles.** The processes of cooling water are among the oldest and simplest known to man. All that is required to cool water is to expose its surface to air. Some of these cooling processes are slow, such as the cooling of water on the surface of a pond; others are comparatively fast, such as the spraying of water into air. These processes all involve the exposure of water surface to air with varying degrees of efficiency.

The heat transfer process involves a latent heat transfer due to change of state of a small portion of the water from liquid to vapor and a sensible heat transfer due to the difference in temperature of water and air. Approximately 1000 Btu are required to evaporate 1 lb of water, which is the amount of heat lost in cooling 100 lb of water 10 F. Therefore, for each 10 F of cooling effected, roughly 1 per cent of water is lost by evaporation. there will be a spray loss of not more than 0.2 per cent in a well-designed atmospheric or mechanical draft tower. Water cooling from 120 to 90 F, for example, will therefore lose 3.2 per cent of its weight (3 plus 0.2 per cent) with each passage through the tower.

In cooling towers in which the water is warmer than the air, the heat removed from the water and transferred to the air is the sum of the sensible heat and the latent heat of evaporation. The sensible heat q_s is small compared to the latent heat transferred, wr.

$$q_t = q_s + wr$$

$$w = kA\triangle p_m$$

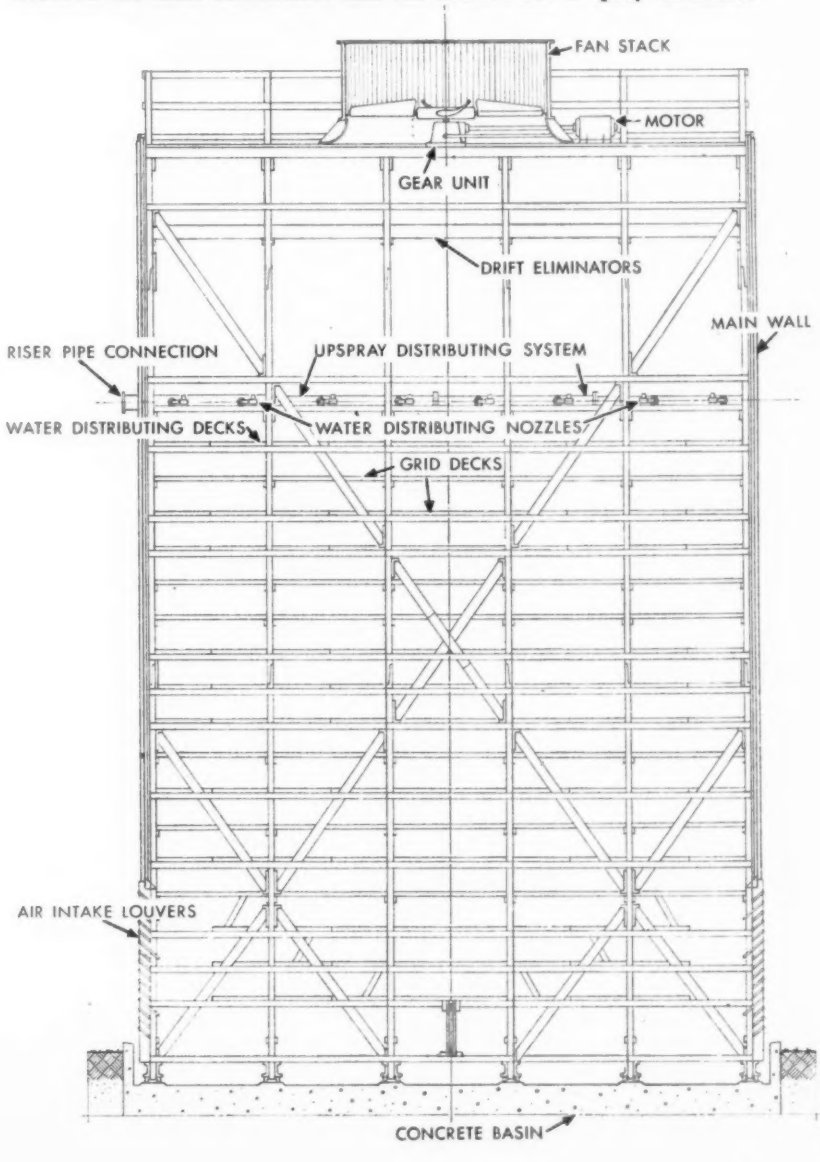
The factors that influence the performance of a cooling tower are therefore those that affect the expression $kA\triangle p_m$. The value kA depends on the construction of the equipment, the extent of water surface exposed through drop surface and filming surface, and the velocity of the air. $\triangle p_m$ depends on the temperature of the water and the temperature and humidity of the air. Actually, $\triangle p_m$ represents the difference in vapor pressure between the water at its temperature and the water if it were at the wet bulb temperature of the air.

It is evident from the above that the water cannot be cooled below the wet bulb temperature of the entering air. The wet bulb temperature, or to be more precise, the adiabatic saturation temperature, represents the minimum temperature that the water would reach with infinite time of contact between water and air in a cooling tower. This must be kept in mind when designing a plant to operate on cooling tower water.

● **General considerations.** As process refinements have appeared, industry has demanded closer and closer control of its production units, resulting in more exacting demands being made upon cooling towers. In many plants, each additional degree of cooling has meant hundreds and even thousands of dollars per day in increased production. It has, therefore, been necessary for the cooling tower industry to produce a tower that would supply the colder water more economically.

There are two types of cooling towers in general use today—the atmospheric (see Fig. 9) and the mechanical draft (see Fig. 2). The older apparatuses for cooling water, i.e., the spray pond and natural draft chimney towers, have been almost exclusively replaced by these two types of cooling towers. The objection to the spray pond is the limited performance available and the nuisance created by the high water loss occurring during certain seasons of the year. The objection to the natural draft tower is the high initial cost and the serious reduction in performance experienced

FIG. 1. Cross-section of a mechanical draft cooling tower. With the upspray distributing system, it is necessary to allow sufficient space between the drift eliminators and the nozzles for a spray chamber.



*Chief cooling tower development engineer.

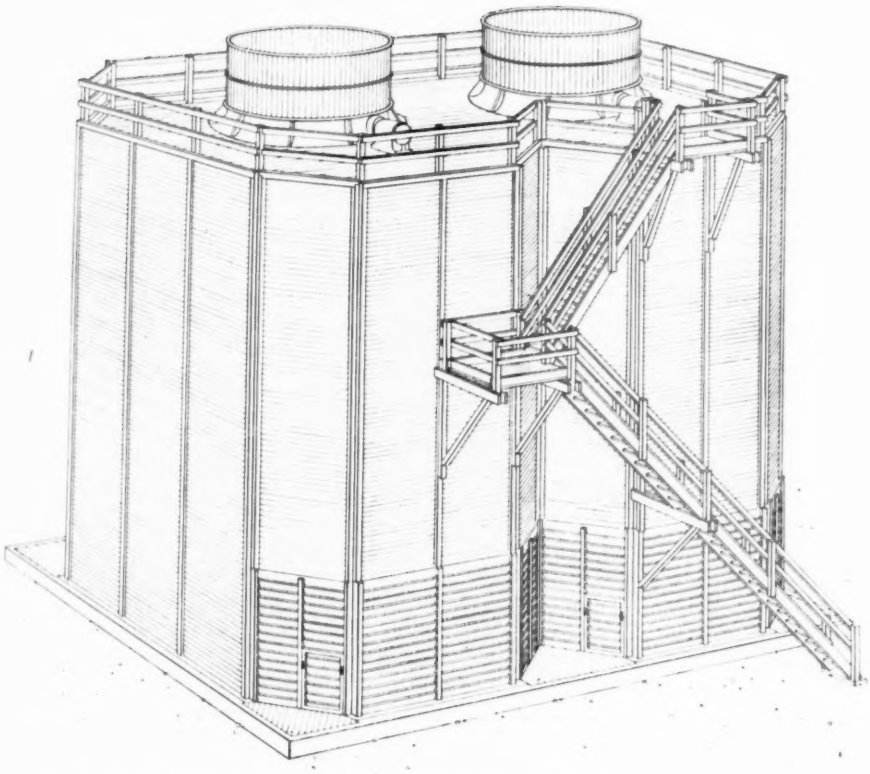
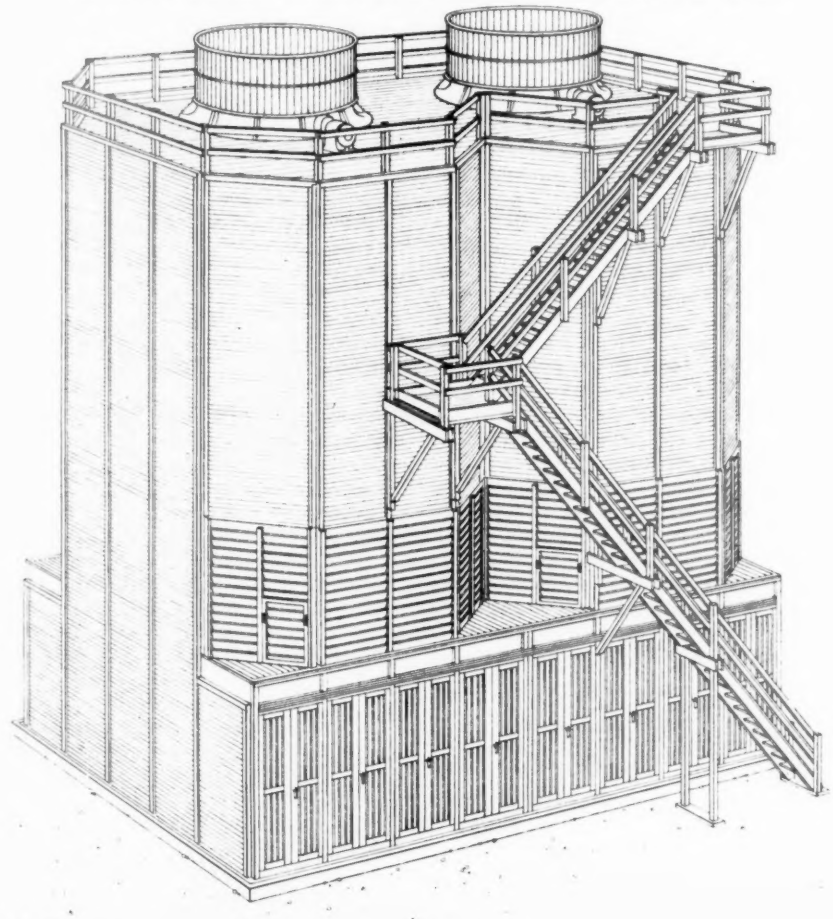


FIG. 2. Modern two-cell mechanical draft cooling tower. Note square corners have been removed to facilitate air distribution within structure.

FIG. 3. Same as Fig. 2, with tower placed over a coil shed. Tower is used to cool water, which, in turn, is used to cool other water, gases or liquids circulated through coils installed in lower part of tower.



during the hot weather. Both the atmospheric and the mechanical draft towers are capable of cooling water to the same minimum temperatures. The economic situation, the prevailing atmospheric conditions, the desired approach to the wet bulb temperature, and the amount of space available, will indicate which type to select.

● **Mechanical draft towers.** There are two types of mechanical draft towers in use today—the forced draft and the induced draft. In the forced draft tower, the fan is mounted at its base and the air is forced in the bottom and discharged through the top at low velocity. In the induced draft tower, the fan is mounted on the roof of the structure and air is pulled upward and discharged at a high velocity.

The forced-draft type is more often subjected to the recirculation of the hot humid exhaust vapors back into the air intakes than the induced-draft type. This occurs under certain atmospheric conditions because the velocity of the humid exhaust air is so low that the suction created by the fans tends to draw it back into the tower. As the wet bulb temperature of the exhaust air is considerably above that of the ambient air, there is a decrease in performance evidenced by an increase in cold water temperature.

Except for the location of the fans, the structural and operational features of the two types of mechanical draft towers are essentially the same. A cross-sectional view of the induced-draft tower with the various parts labeled is shown in Fig. 1. The entrained moisture is removed from the exhaust air by the drift eliminator, which is placed just above the spray chamber and below the fan. The water is pumped to the main header situated in the top of the tower where it is distributed to the various nozzles. This water is sprayed up in a manner similar to that used in a spray pond and is intimately mixed with the exhaust air before dropping to the decks below. (In performance, the upspray distributing system represents the equivalent of adding 8 or 9 ft to the height of the cooling tower over that of the gravity-type system). The fall of the water is interrupted by the slat-type grids as it flows countercurrently to the air. In flowing countercurrently, the coldest water contacts the driest air and the warmest water contacts the most humid air. Maximum performance is thus obtained, for the temperature of all the cold water is approaching the wet bulb temperature of the entering dry air. This was not true of the older cross-flow and parallel-flow type cooling towers.

The performance of a given type cooling tower is governed by the ratio of the weights of air to water and the time of contact between water and air. In commercial practice, the variation in the ratio of air to water is first obtained by keeping the air velocity constant at about 350 fpm per sq ft of active tower

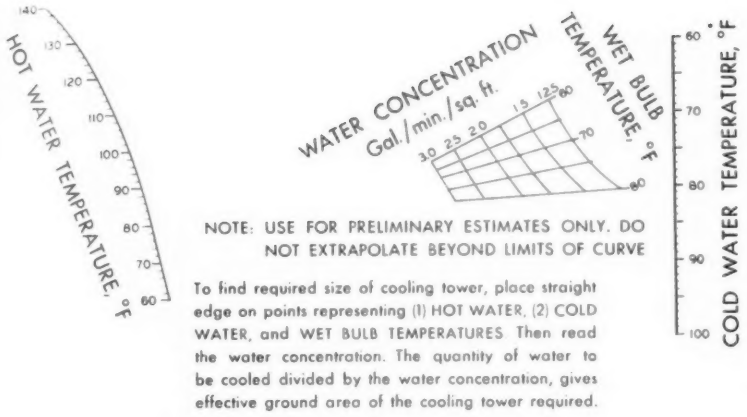


FIG. 4. Sizing chart of mechanical draft cooling tower.

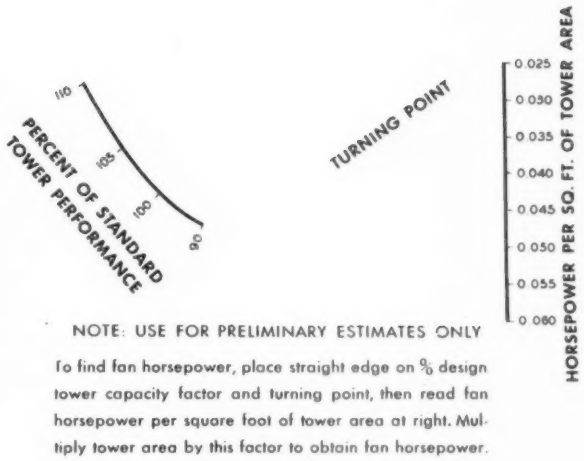

PERCENT OF STANDARD TOWER PERFORMANCE
110
105
100
90
TURNING POINT
HORSEPOWER PER SQ. FT. OF TOWER AREA
0.025
0.030
0.035
0.040
0.045
0.050
0.055
0.060
NOTE: USE FOR PRELIMINARY ESTIMATES ONLY
To find fan horsepower, place straight edge on % design tower capacity factor and turning point, then read fan horsepower per square foot of tower area at right. Multiply tower area by this factor to obtain fan horsepower.

FIG. 5. Horsepower chart of draft cooling tower.

area and varying the water concentration (gpm per sq ft of tower area). As a secondary operation, the air velocity is varied to make the tower accommodate the cooling requirement. The time of contact between water and air is governed largely by the time required for the water to discharge from the nozzles and fall through the tower to the basin. The time of contact is, therefore, obtained in a given type of unit by varying the height of the tower. Should the time of contact be insufficient, no amount of increase in the ratio of air to water will produce the desired cooling. It is therefore necessary that a certain minimum height of cooling tower be maintained. Where a wide approach* of 15 to 20 F to the wet bulb temperature and a 25 to 35 F cooling range** is required, a relatively low cooling tower will suffice. A tower in which the water travels 15 to 20 ft from the distributing system to the basin is sufficient. Where a moderate approach of 8 to 15 F and a cooling range of 25 to 35 F is required, a tower in which the water travels 25 to 30 ft is adequate. Where a close approach of 4 to 8 F, with a 25 to 35 F cooling range is required, a tower in which the water travels from 35 to 40 ft is required. It is usually not economical to design a cooling tower with an approach of less than 4 F, but it can be satisfactorily accomplished with a tower in which the water travels 35 to 40 ft.

Fig. 4 shows the relationship of the hot water, cold water, and wet bulb temperatures to the water concentration. From this, the minimum area required for a given performance of a well-designed counterflow induced draft cooling tower can be obtained. Fig. 5 gives the horsepower per sq ft of tower area required for a given performance. These curves do not apply to parallel or crossflow cooling, for these processes are not as efficient as the counterflow process. Also they do not apply where the approach to the cold water temperature is less than 5 F. These charts should be considered approximate and for preliminary estimates only. Many factors not shown in the graphs must be included in the computation and hence the manufacturer should be contacted for final design recommendations.

The cooling performance of any tower containing a given depth of filling varies with the water concentration. It has been found that the maximum contact and performance is obtained with a tower having a water concentration of 2 to 3 gal of water per min per sq ft of ground area. Thus, the problem of calculating the size of a cooling tower becomes one of determining the proper concentration of water required to obtain the desired results. A higher tower will be required if the water concentration falls below

*The approach is the difference between the cold water temperature and the wet bulb temperature.

**The cooling range is the difference between the hot water temperature and the cold water temperature.

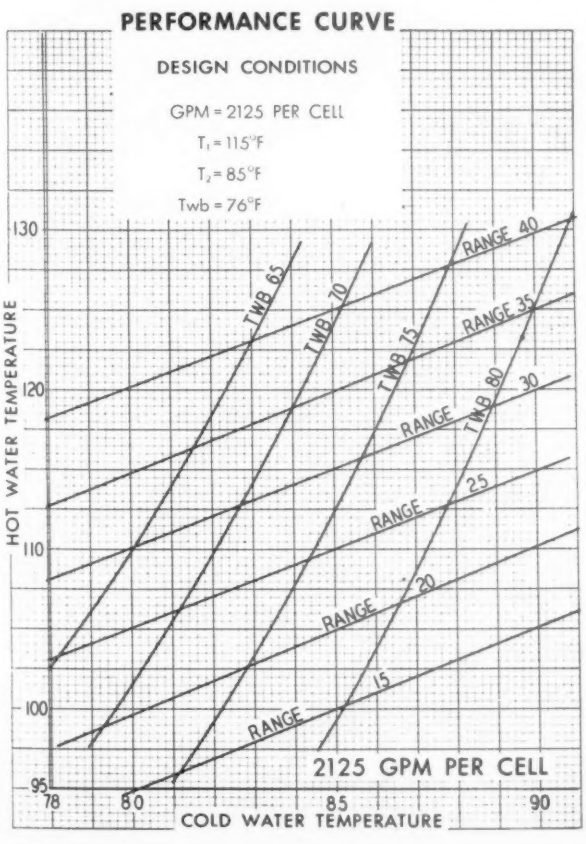


FIG. 6. Typical performance curve for mechanical draft cooling tower.

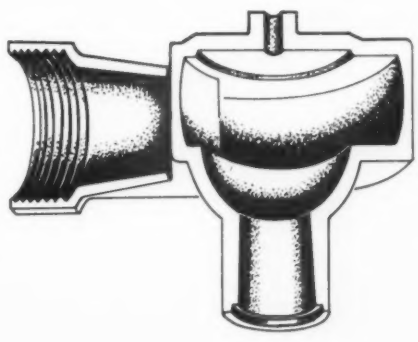


FIG. 7. Cutaway view of upspray nozzle shows side entrance, which starts the spiral action upward to the discharge orifice. Removable screw plate can be drilled as shown for automatic drainage to prevent winter freezing.

FIG. 8. NOZZLE CAPACITY TABLE.

Nozzle no.	Pipe size, in.	Orifice size, in.	Pressure, psi										
			5	6	7	8	9	10	12	15	20	25	30
			Capacity in gpm (U. S. gal)										
2.4	3/8	3/16	..	..	1.0	1.1	1.2	1.3	1.4	1.6	1.8	2.0	2.2
2.4	3/8	5/16	1.8	1.9	2.1	2.2	2.3	2.3	2.7	3.0	3.4	3.8	4.2
7	1	7/16	6.5	7.1	7.7	8.2	8.7	9.2	10.1	11.3	13.1	14.6	16.0
14	1	5/8	11.5	12.6	13.6	14.5	15.4	16.2	17.7	19.8	22.7	25.3	27.8
19	1½	5/8	16.8	18.3	19.8	21.1	22.4	23.5	25.8	28.7	32.9	36.5	40.0
24	1½	1	20.0	22.0	23.8	25.3	26.9	28.3	31.0	34.7	40.0	44.8	49.0
39	2	1¼	33.0	36.2	39.0	41.8	44.3	46.7	51.0	57.0	65.8	73.3	80.0
49	2½	1²⁵/₃₂	39.5	43.0	46.5	49.5	52.5	55.0	60.5	67.0	78.0	86.0	94.0

1.6 gal per sq ft. Should the water concentration exceed 3 gal per sq ft, a lower cooling tower may be used. Once the necessary water concentration is obtained, the tower area can be calculated by dividing the gpm circulated by the water concentration gal per sq ft. The required tower size then is a function of the following:

1. Cooling range (hot water temperature minus cold water temperature.)
2. Approach to wet bulb temperature (cold water temperature minus wet bulb temperature.)
3. Quantity of water to be cooled.
4. Wet bulb temperature.
5. Air velocity through the cell.
6. Tower height.

To illustrate the use of the charts let us assume that we have the following cooling conditions:

Hot water temperature = 102 F
Cold water temperature = 78 F
Wet bulb temperature Twb) = 70 F
Gpm = 2000

Laying a straight edge across Fig. 4 and connecting the points representing the design water and wet bulb temperatures, we find that a water concentration of 2 gal per sq ft is required. Dividing the quantity of water circulated by the water concentration, we find that the theoretical area of the tower is 1000 sq ft.

To obtain the theoretical fan horsepower, we use Fig. 5. Connecting the points representing the 100 per cent of standard tower performance with the turning point, we find that it will require 0.041 hp per sq ft of actual effective tower area. Multiplying by the tower area of 1000 sq ft, we find that it requires 41 fan horsepower to perform the necessary cooling.

Suppose that the commercial tower size is such that the actual tower area is 910 sq ft. We can still obtain the cooling equivalent to 1000 sq ft of standard tower area by increasing the air velocity through the tower. Within reasonable

FIG. 9. Cross-section of atmosphere type cooling tower. The function of the drift eliminators on the sides is to separate entrained water from the discharging air stream, reducing airborne drift loss to a minimum.

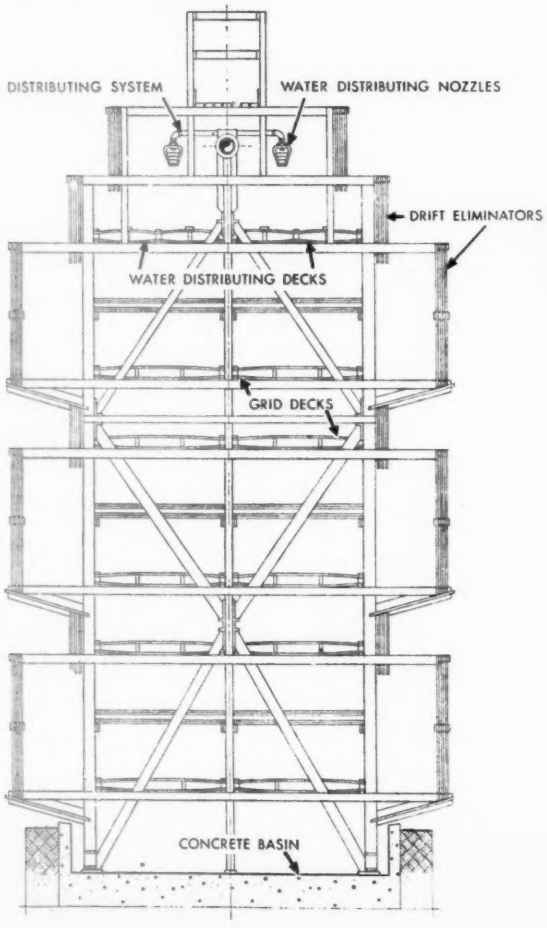


FIG. 10. Typical atmospheric-type cooling tower.

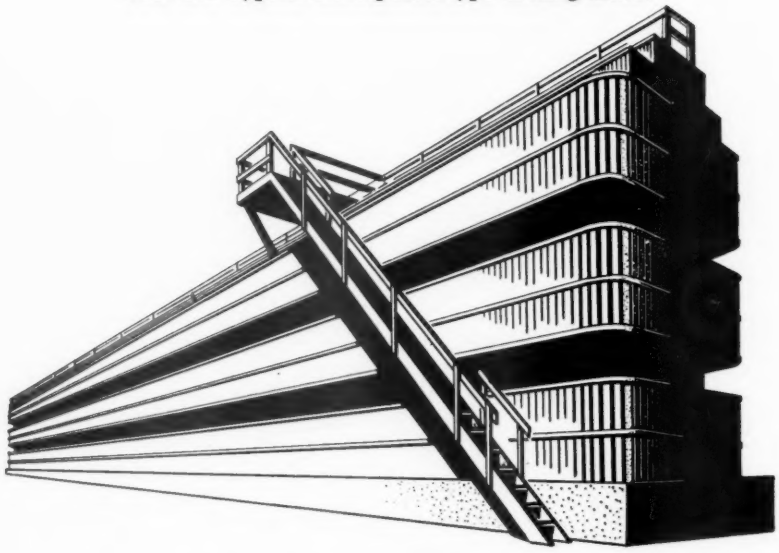
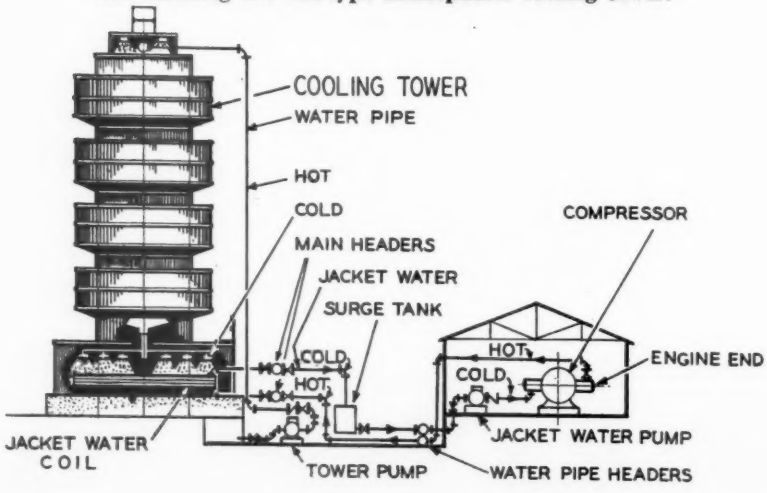


FIG. 11. Typical flow diagram for a closed cooling system utilizing the coil-type atmospheric cooling tower.



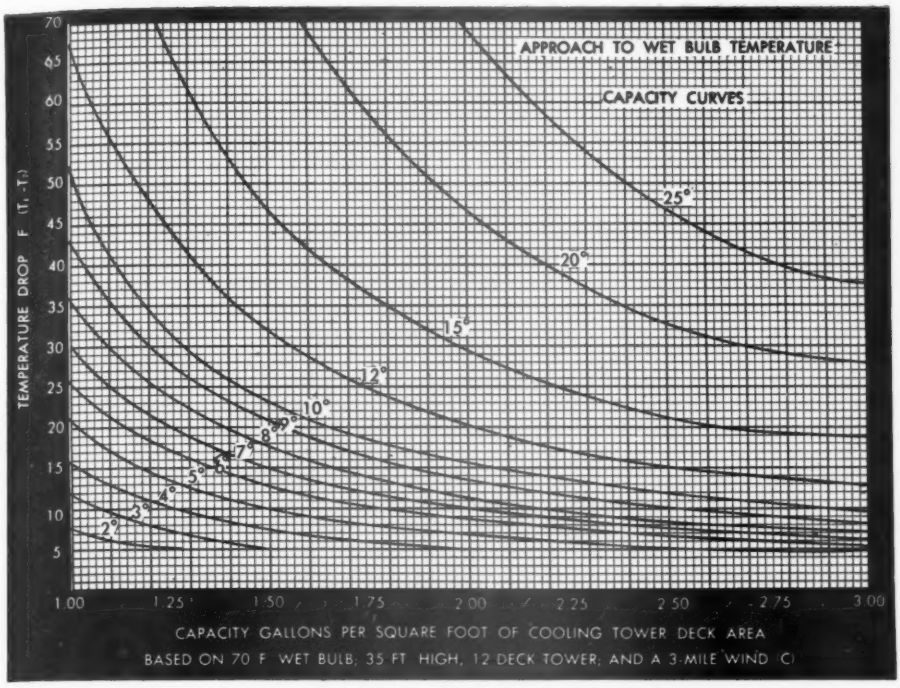


FIG. 12. Capacity curves for atmospheric-type cooling towers.

limits, the shortage of actual area can be compensated for by an increase in air velocity through the tower, which, in turn, requires a higher fan horsepower. Our problem then becomes one of increasing the performance of the smaller tower by 10 per cent. From Fig. 5, by connecting the points representing 110 per cent of standard tower performance and the turning point, the fan horsepower is found to be 0.057 hp per sq ft of actual tower area, or $0.057 \times 910 = 51.9$ hp.

On the other hand, suppose the commercial tower size is such that the actual tower is 1110 sq ft, the cooling equivalent to 1000 sq ft of standard tower area can be accomplished with less air and less fan horsepower. By the use of Fig. 5, the theoretical fan horsepower for a tower doing only 90 per cent of standard performance is found to be 0.031 per sq ft of actual tower area or 34.5 hp.

This illustrates how sensitive the fan horsepower is to small changes in tower area. The importance of designing a tower that is slightly oversize in ground area becomes immediately apparent.

Assume that we have the same cooling range and approach as used in the first example, except that the wet bulb temperature is lower. The design conditions would then be:

Gpm =	2000
Range =	24 F
Approach =	8 F
T_1 =	92 F
T_2 =	68 F
Wet bulb temperature (Twb) =	60 F

From Fig. 4, we find the water concentration required to perform the cooling is 1.75, giving a theoretical tower area of 1145 sq ft as compared with 1000 sq ft for a 70 F wet bulb temperature. This shows that the lower the wet bulb temperature for the same cooling range and approach, the larger the area of the tower required and therefore the more difficult the cooling job.

The problem of estimating the performance of an existing tower at other than design conditions is often encountered by the plant operator. For example, suppose we have a tower that was designed for the following conditions:

Gpm =	1000
Range =	30 F
Approach =	10 F
T_1 =	110 F
T_2 =	80 F
Wet bulb temperature =	70 F

What will the cold water temperature (T_2) be when the wet bulb temperature (Twb) drops to 60 F, providing of course, that the heat load and water quantity remain constant? From Fig. 4, we find that the water concentration is 2.0 gal per sq ft at design conditions. This water concentration does not change since the volume of water and the tower area remain constant. With the water concentration at 2.0 and the wet bulb temperature at 60 F, by adjusting the angle of the straight edge on Fig. 4 until we obtain a 30 F differential between the hot water and cold water temperatures, we find the hot water temperature to be 103 F, and the cold water temperature to be 73 F.

Suppose now, that the above designed tower had 1500 gpm flowing through it, and the total heat load remained constant, what would the cold water temperature be when the wet temperature is 65 F. The design heat load was $1000 \times 8.33 \times 30 = 250{,}000$ Btu per min.

The new cooling range (heat load remaining constant) when circulating 1500 gpm over the tower would be

$$\frac{250{,}000}{1500 \times 8.33} = 20 \text{ F}$$

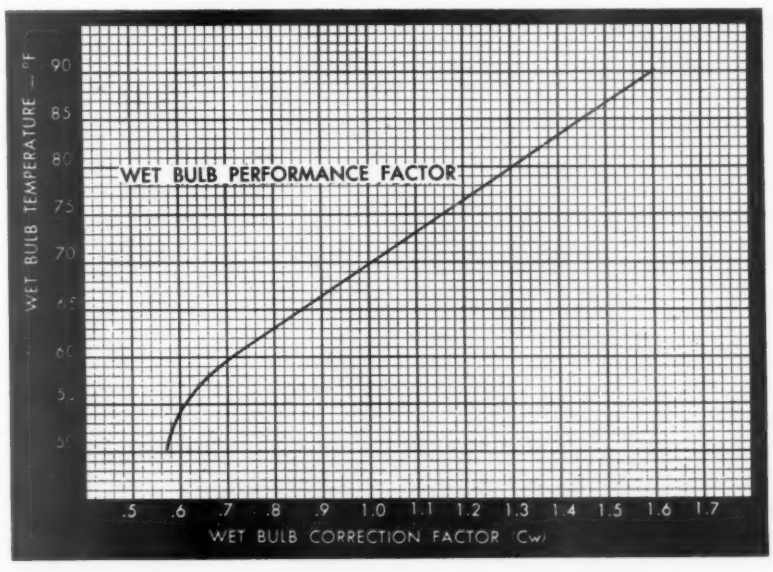
Theoretically, the design area of the tower from Fig. 4 was 500 sq ft (1000 gpm ÷ 2 gal per sq ft = 500 sq ft). The water concentration when circulating 1500 gpm is

$$\frac{1500}{500} = 3 \text{ gal per sq ft.}$$

Now, referring to Fig. 4, with a water concentration of 3 gal per sq ft and 65 F wet bulb temperature, adjust the straight edge until a difference of 20 F exists between the hot water and cold water temperatures. This shows the hot water temperature to be 100 F and the cold water temperature to be 80 F.

This indicates that the possibility of a lower cold water temperature obtained by the lower existing wet bulb temperature was lost due to the adverse effect of the increased water quantity.

FIG. 13. Wet bulb performance factor.



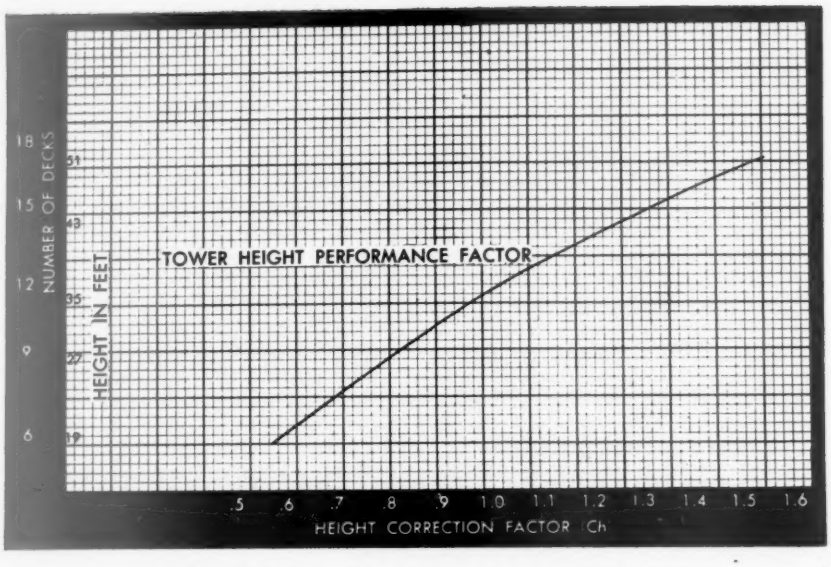


FIG. 14. Tower height for performance factor.

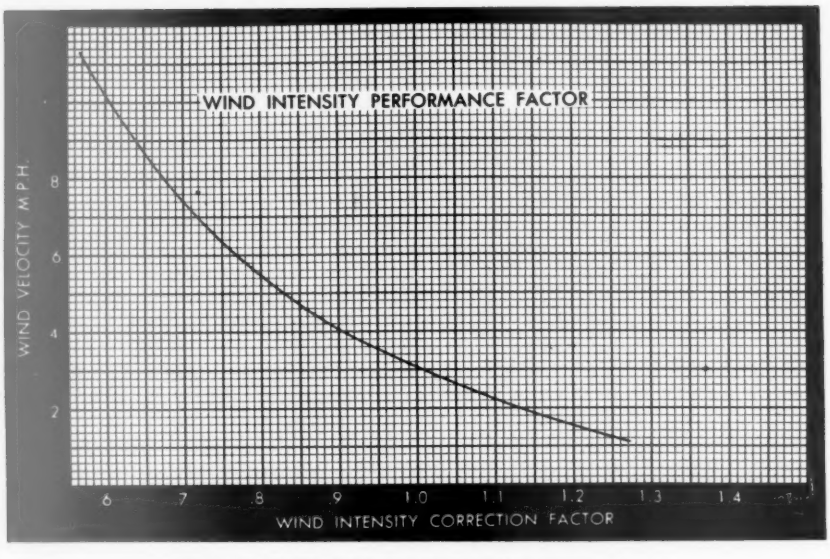


FIG. 15. Wind intensity performance factor.

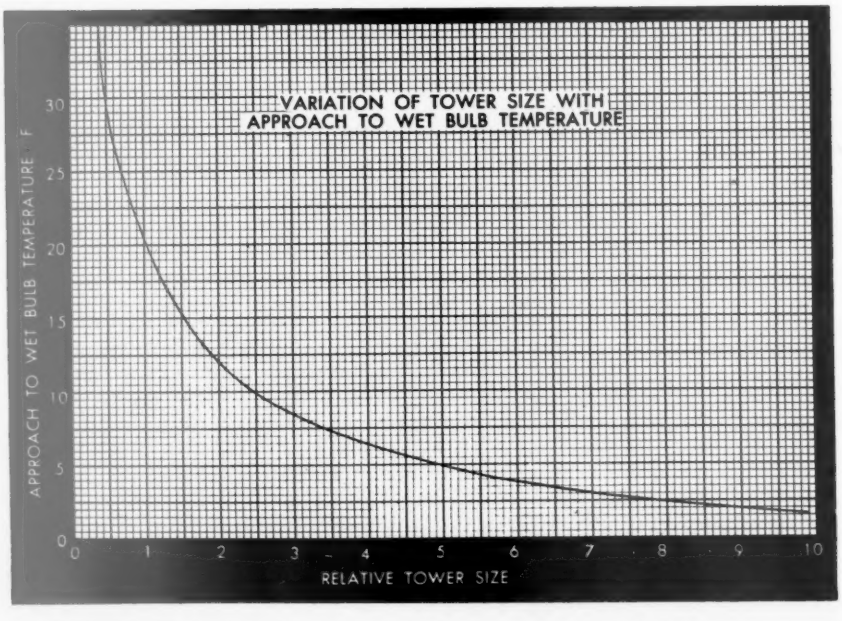


FIG. 16. Variation of tower size with approach to wet bulb temperature.

Fig. 6 shows the type of performance curve provided by the cooling tower manufacturer. This shows the variation in performance with change in wet bulb and hot water temperature, while maintaining the water quantity constant.

● **Cooling tower spray nozzles.** The type of nozzles used in upspray cooling tower distributing systems is shown in Fig. 7. The accompanying table (Fig. 8) gives the performance of a particular family of nozzles. In the upspray distributing systems, a pressure of 7 psi is common practice; however, 5 psi is adequate.

This nozzle is of the non-clogging type. It does not depend on small orifices to obtain minimum drop-size, but rather upon centrifugal force. The water is given a spiral action by its tangential entrance into the spiral chamber. The dome-shaped approach to the discharge orifice increases this spiral action as it approaches the discharge orifice. This whirling action, which generates the necessary velocity for fine breakup, assures uniform drop-size and efficient water distribution over a maximum area. This formation of uniformly small drops assures maximum contact with air, resulting in high cooling efficiency.

● **Atmospheric cooling towers.** A cross-sectional view of a typical atmospheric cooling tower is shown in Fig. 9. In atmospheric towers, the water is pumped to the top of the tower, where it is discharged through a distributing system. As the water begins its downward flow, it is broken up and redistributed by the decks that comprise the filling of the tower. This continually creates newly exposed cooling surface for the air (passing horizontally through the tower) to encounter. The redistribution insures even concentration of water throughout the tower during its entire fall.

Although initial cost for an atmospheric cooling tower (designed for a 3-mile wind) is about the same as that for a mechanical draft tower, there are certain important limitations governing its performance. It must be placed broadside to the prevailing wind in an exposed area. Any surrounding structures, hills, or other barriers would tend to block off the wind.

Originally, the main objection to atmospheric towers was the excessive spray loss occurring during periods of high winds. This high loss was caused by the lack of a method of separating the entrained water from the air in the conventional louver-type tower. As a result, most manufacturers now have solved this problem by means of incorporating drift eliminators into the louvers. A typical example of this type of tower is shown in Fig. 10.

The method of determining the size and performance of an atmospheric type tower is shown on the accompanying charts. The purpose of these charts is to show the method of estimating the approximate size of an atmospheric type cooling tower to meet a given demand.

Here is an unusual power plant that goes places and does things . . . savings-wise! The truck-mounted Diesel is a husky 8-cylinder, turbo-supercharged Cooper-Bessemer rated 450 hp at 720 rpm, direct-driving an AC generator.

This roving power plant and three others just like it, all Cooper-Bessemer equipped, belong to a progressive oil line company in the southwest. All four are used as *portable standbys* to permit the maintenance and overhaul of stationary main line units. They simply roll up to a station and go to work, supplying power to replace that of one of the regular units while the latter is shut down. Thus there's no need to provide for permanent standby power in each and every station. This extra expense burden is held to a practical minimum.

Whether your power needs call for portable or stationary service, for conventional Diesels, gas engines, or the revolutionary gas-Diesels, there are modern, efficient Cooper-Bessemers from 110 to 1800 hp that will fit your requirements to a "T"! Get in touch with the Cooper-Bessemer office near you for helpful cooperation.

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The cooling capacity of any tower, with a given wet bulb temperature and wind velocity, varies with the water concentration. Thus, the problem of calculating tower size becomes nothing more than obtaining the correct water concentration for one of chosen height, which will operate under a certain wind velocity and wet bulb temperature. Once this water concentration factor is obtained, the area of a given height tower can easily be calculated by dividing the gallons per minute circulated by the concentration factor.

The concentration required to produce desired cooling depends primarily on the following conditions:

1. Temperature range (T_1—T_2)
2. Approach to wet bulb temperature (T_2—Twb)
3. Tower height
4. Wind velocity
5. Wet bulb temperature (Twb)

It is easily seen that because of the infinite number of possible combinations of these values, it is impractical if not impossible to have one curve from which to obtain the correct concentration factor. Fig. 12 gives the required concentration for cooling water through a certain range and with a certain approach to the wet bulb temperature, *but* this curve assumes a wet bulb temperature of 70 F, tower height of 35 ft, and a wind velocity of 3 mph. Assume that the conditions given are unity. Then should any of these three values change, the concentration would have to be corrected for the new conditions by using one or more of the correction factors shown on Figs. 13, 14, and 15.

Let us see how a variance of any of the three aforementioned conditions would affect the concentration of water.

1. *Wind velocity.* The higher the wind velocity the greater the amount of air that goes through the tower. This results in greater cooling. Therefore, when the wind velocity is higher, the concentration can be greater and still obtain equal cooling†.

2. *Tower height.* In general, it is found in atmospheric as well as mechanical draft towers that the greater the cooling range and the closer the approach to the wet bulb temperature, the higher will be the tower required to give sufficient time of contact between water and air to accomplish the desired cooling. In atmospheric towers, the performance is limited by both maximum and minimum water concentrations. Should the water concentration fall below 1 gpm per sq ft of tower area, it will be necessary to employ the next size higher tower. This is because in extremely light water concentrations the water will not be uniformly distributed and the performance as predicted by the accompanying curves will not be achieved. Should the water concentration exceed 3 gpm per sq ft of tower area, it will then be necessary to choose the next size lower tower. The higher water concentrations tend to blanket the tower and will not allow sufficient air to pass through to accomplish the cooling shown on the curves.

3. *Wet bulb temperature.* Theoretically, a cooling tower cannot cool water to a temperature lower than the prevailing wet bulb temperature. Being limited by this fact, one is more interested in the economic approach of the cold water temperature to this temperature. Air has a greater capacity for absorbing heat at the higher wet bulb temperature. At the lower wet bulb, air, in passing through the tower, must have a greater temperature rise to accomplish the same cooling. Therefore, to obtain the same approach at the lower wet bulb temperatures it is necessary to reduce the concentration.

To calculate the size of an atmos-

†In deciding upon a design wind condition, it is well to bear in mind that there is a period occurring during the day and night in which the prevailing wind shifts. When this occurs, there is a short period when there is little or no air movement. During such period, the tower water temperatures will rise from 2 to 5 F, depending on the duration of the calm and the design wind velocity. This should be evaluated in determining a design wind velocity; however, one should be aware of the fact that many atmospheric towers are designed to operate successfully at a zero wind condition.

Fertilizer by the tank

One of these days farmers may be buying their fertilizer by the tank instead of the ton. Tests with ammonia gas (which can be made from petroleum) as a way of putting nitrogen into the soil continue to look good. A pressure tank is mounted on a tractor and tubes from the tank run down to four shovels mounted on a cultivator. The gas is shot into the ground under pressure to a 5½-in. depth.

FIG. 17. Three-cell mechanical draft cooling tower built for a large eastern tire company.

Continental to build small TCC unit at Denver

THIRD SMALL TCC LICENSED SINCE WAR
WILL BE FIRST CAT-CRACKER IN COLORADO

As an important part of a $4,000,000 construction program to enlarge its Denver refinery, Continental Oil Company has contracted to build a new small T C C unit of 3,300 B/D fresh feed capacity. Engineering and design of the new unit are already under way and its completion is scheduled for early 1948.

Although the new unit will be the first cat-cracker to be built in Colorado, it will be Continental's fourth T C C, three others of larger capacity having been operating since early 1944 in the company's Ponca City refinery. Improved features of design and construction, which will be incorporated in the new unit, will provide a higher yield of motor fuel than any single catalytic cracking unit in existence.

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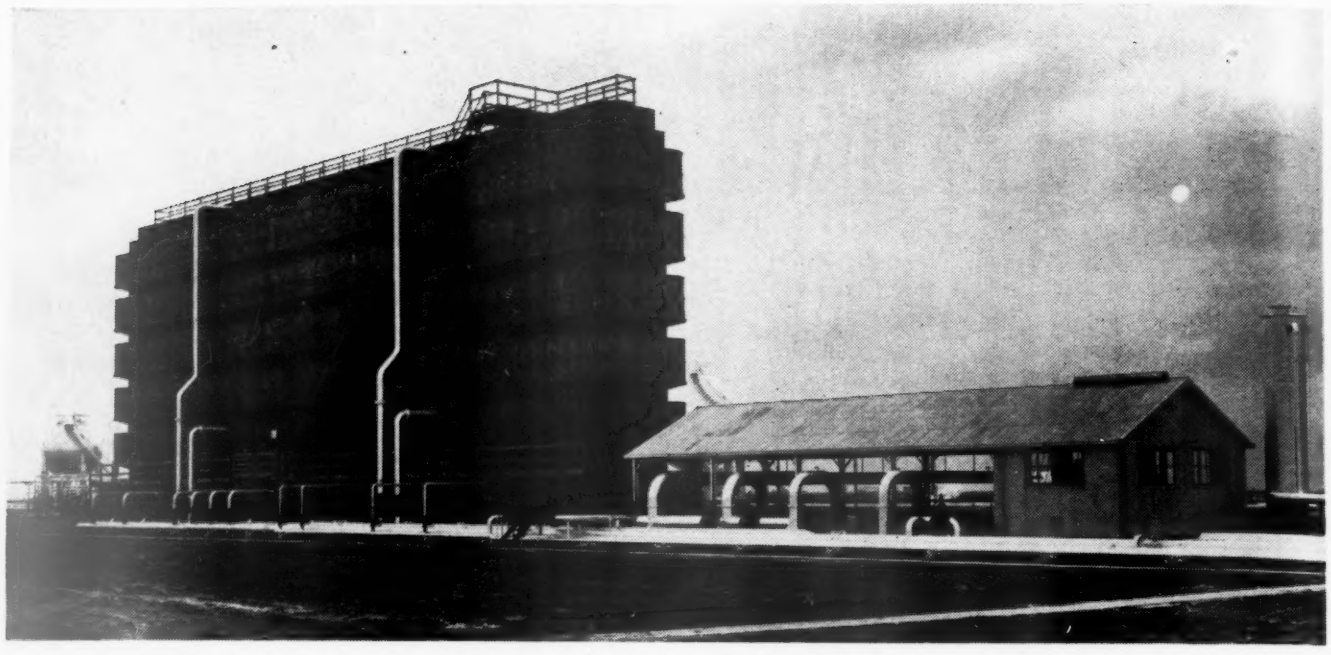


FIG. 18. Atmospheric cooling tower at large western cycling plant. Jacket water pump house at right.

pheric type cooling tower with effective width of 12 ft the following general formula may be used:

$$L = \frac{Gpm \times W}{C \times 12 \times Cw \times Ch}$$

When:

L = length of tower, ft,
Gpm = quantity of water, gpm,
W = wind correction factor,
C = concentration of water per sq ft of cooling tower area,
Cw = wet bulb correction factor,
Ch = tower height correction factor,
T_1 = inlet temperature,
T_2 = outlet temperature,
$(T_1 - T_2)$ = temperature range,
Twb = wet bulb temperature,
$(T_2 - Twb)$ = approach to wet bulb temperature.

Problem No. 1: Determine the length of a 35 ft high tower required to cool 1500 gpm from 90 F to 75 F with a 70 F wet bulb temperature and a 3 mph wind. From these conditions we know that the approach $(T_2—Tw) = 5$ F and the range $(T_1—T_2) = 15$ F. From Fig. 12, it is found that these two values require a concentration of C = 1.17. The correction factors, Ch, Cw, and W will be equal to one, as shown on their respective correction factor curves, because Fig. 12 was based upon values equal to those given in the problem. Substituting the corresponding values on the above formula we find that a tower 107 ft long is required.

Problem No. 2: Let us take the same conditions that exist in Problem No. 1 and see what the effect would be when the wind velocity is increased to 5 mph. From Fig. 15, when the wind velocity is 5 mph, W = 0.80. Substituting this value for W in the formula, we find that an 85.3 ft long tower is required.

Problem No. 3: Again assume the same conditions as Problem No. 1, except that due to space considerations it is necessary to have a 51 ft high tower. From Fig. 14, when tower height is 51 ft, Ch = 1.63. Substituting the new Ch in the formula we find that a 65½ ft long tower is required.

Problem No. 4: Assume the conditions of this problem are identical to those of Problem No. 1, except that water has to be cooled from 85 F to 70 F and the wet bulb temperature is 65 F. From Fig. 13, when the wet bulb temperature is 65 F, Cw = 0.86. Substituting this factor in the general formula we find tower length to be 124 ft.

Problem No. 5: Once a tower is installed the problem often arises of determining what cold water temperature one can expect under conditions differing from those for which the tower was designed. For example, let us take the tower calculated for Problem No. 1. This is 35 ft high, 12 ft wide, and 107 ft long. What cold water temperature, T_2, can be expected when the wet bulb temperature is 60 F, wind velocity 4 mph, cooling range 15 F, and water circulation 2000 gpm?

The wet bulb temperature correction factor Cw from Fig. 13 is 0.71. The wind velocity correction factor (W) from Fig. 15 is 0.875. By substituting these values in the general formula and solving for water concentration, we find:

$$C = \frac{2000 \times 0.875}{107 \times 12 \times 0.71 \times 1}$$

$$= 1.92 \text{ gal per sq ft.}$$

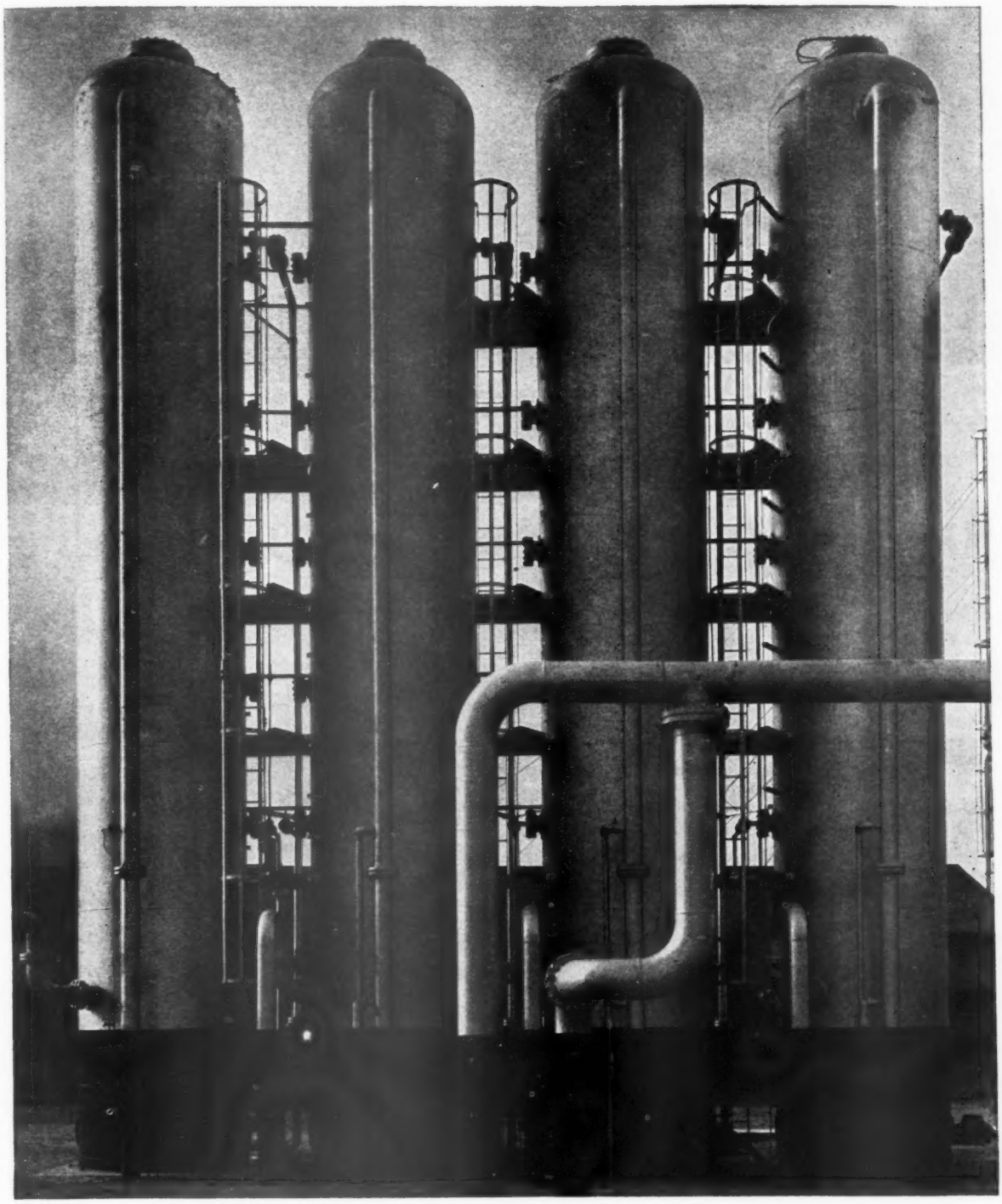
Turning to Fig. 12, we find that when the cooling range is 15 F and the water concentration is 1.9, the approach to the wet bulb temperature is 9 F. This means that the cold water temperature will be 60 F + 9 F = 69 F.

The general information given is presented solely for the purpose of showing the more important factors that affect the design of atmospheric type cooling towers. Space does not allow consideration of the effect of excessive or insufficient concentration, higher relative humidity, change in wind direction, and other finer points that must be analyzed for proper cooling tower selection. Therefore, it is to be noted that the cooling tower sizes calculated in the given examples are only approximate. This survey, although presenting the essentials, has purposely been kept as non-technical as possible in order that it may serve as a guide to the plant operator in evaluating cooling tower performance. ★★★

Repressuring saves

As a result of systematic repressuring operations, oil producers have been able to increase oil production by more than 13,000,000 bbl during the past 20 years in the eastern part of the Delaware-Childers field in Nowata County, Oklahoma, the Bureau of Mines reported in an engineering survey released by Dr. R. R. Sayers, director of the Bureau.

Since this method of secondary recovery was started in 1925, more than 51 billion cubic feet of air and gas have been injected into 500 selected injection wells.



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Aerial view of Humble's Clear Lake natural gasoline plant, which processes 50,000,000 cu ft casinghead and natural gas a day.

Humble gas conservation program

CONSERVATION of casinghead gas has been receiving serious attention during the last ten years as one of the oil industry's major problems. Because this gas is produced in relatively small quantities from individual oil wells scattered over wide areas, most of it has been flared until recent years because of the lack of market oulets, except for drilling and other field uses.

Study of the entire conservation problem and of the scientific methods and equipment necessary to gain increased recovery of oil and gas has gone ahead rapidly in Texas. Organized thinking and planning on casinghead gas conservation was taking concrete form when the war began. Although shortages and restrictions retarded plans, a broad program was initiated by the industry to meet the problem in a widespread manner at the close of the war. Movement of the chemical industry to the Gulf Coast area and the opening of greater markets for dry gas by the construction of big interstate pipe lines into Texas has given impetus to the casinghead conservation program.

Among the leaders who were in position to move forward with plans laid during the war was Humble Oil and Refining Company. In August, 1945, Humble announced authorization of approximately $3,500,000 for the construction of a series of projects designed to conserve for productive use some 56,000,000 cu ft a day of casinghead gas in the Gulf Coast area. Since that original announcement Humble's program has been expanded greatly to provide for a larger number of projects designed to handle a much greater volume of gas.

Humble's investment in gas conservation projects in the current program is considerably in excess of $10,000,000. Most of the projects are in the Gulf Coast area of Texas and Louisiana.

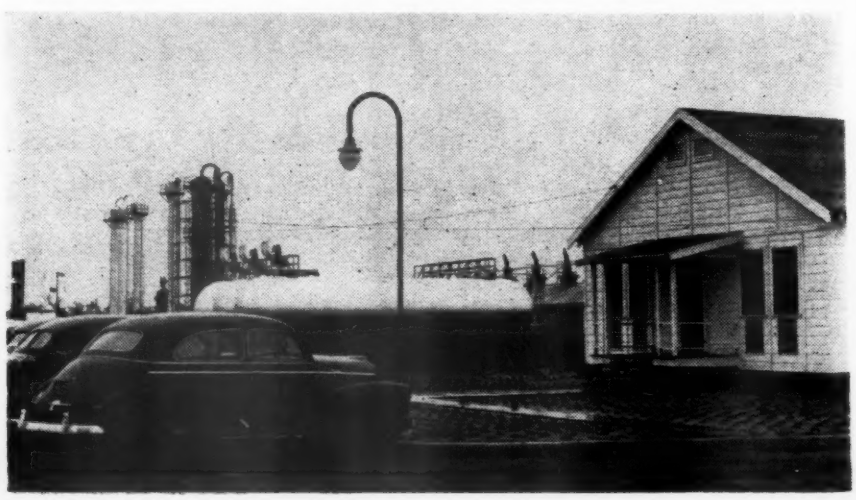
Projects that have been built or are under construction by Humble and jointly by Humble and other operators include:

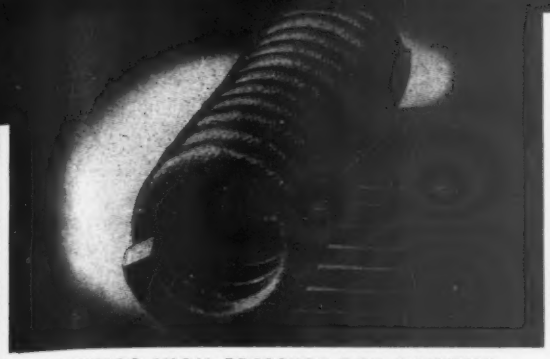
A 1600-hp compressor station was added in the North Crowley, Louisiana, field to make possible the delivery of 8,000,000 cu ft a day of dry gas from the North Crowley oil field into transmission lines. This project was completed in April, 1946, at a cost of $390,000.

Compressors were added at the company's Lovell Lake plant to make possible the gathering and processing of an additional 4,500,000 cu ft a day of gas and to boost the pressure so that the gas can be delivered into a transmission line already connected to the field. This unit was completed in May, 1946, at a cost of about $170,000.

In the Amelia field Humble added a 600-hp compressor station late in 1946 to put casinghead gas from oil wells back into the ground at a pressure of

Office for Clear Lake plant is at right, with some refining equipment shown in left background. Three metal cylinders in center hold liquid products.





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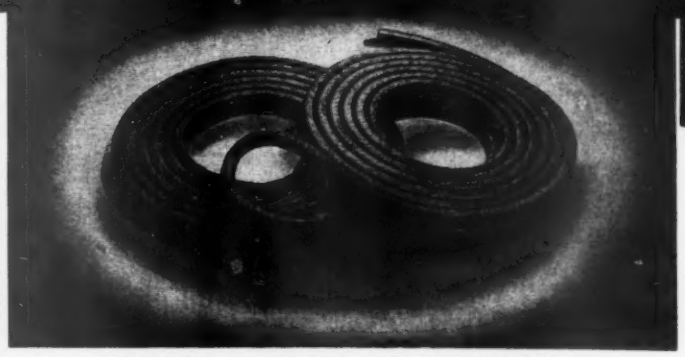

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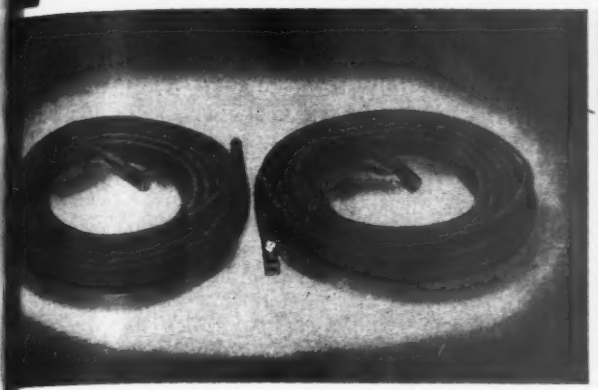

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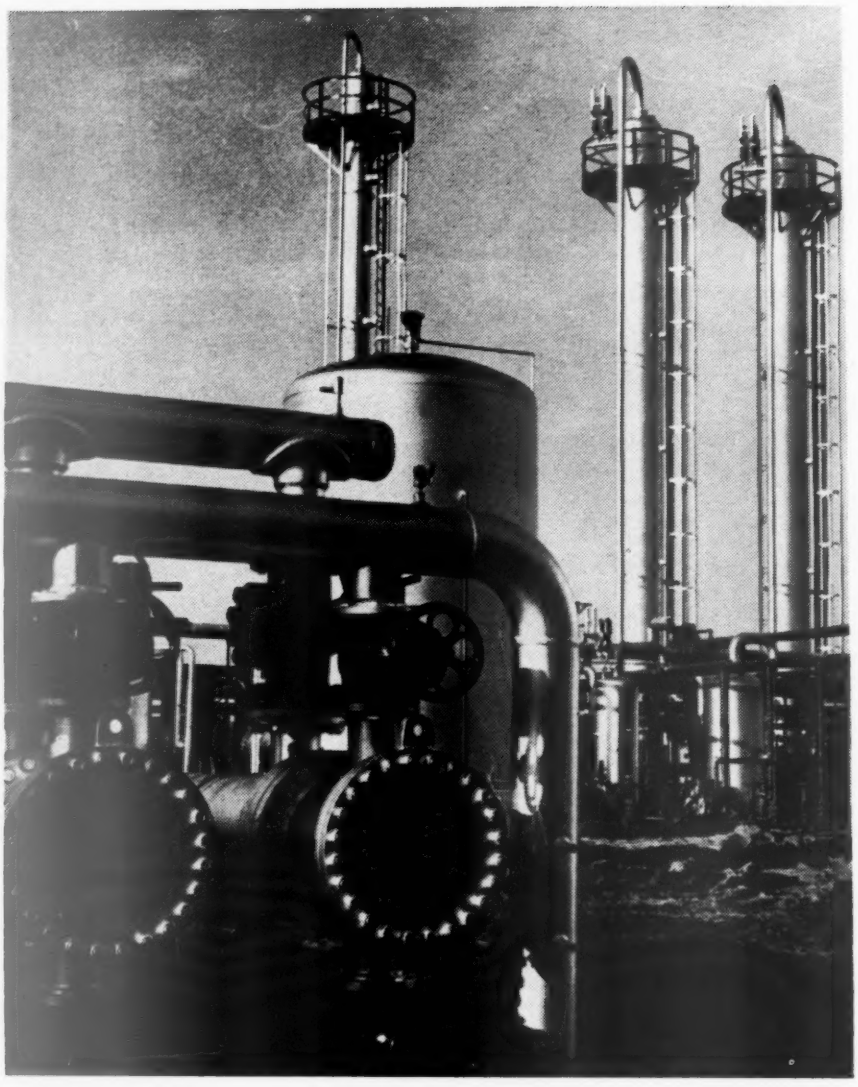
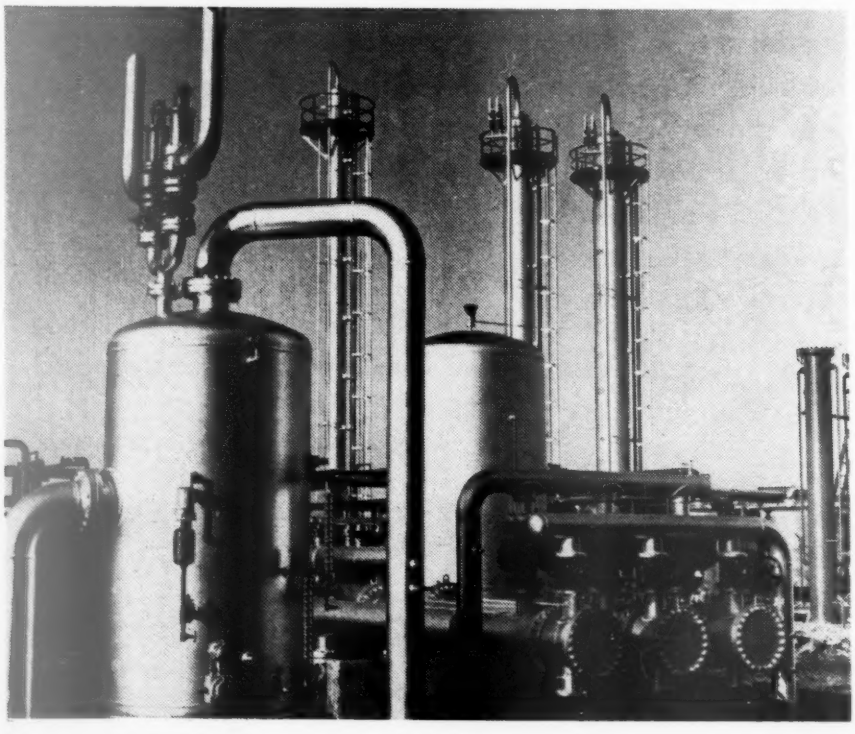


Two absorber towers, right; reabsorber tower, center, and part of heat exchangers, in the left foreground, are shown at the Clear Lake plant. Another view of process equipment shows scrubber tank, left foreground.



2600 psi. Approximately 2,500,000 cu ft of gas, formerly flared, has been returned daily to the sand since December 1, 1946, to repressure the oil zone. Cost of this project was $165,000.

Early this year there was completed at the Katy Cycling Plant a $500,000 low pressure system that processes some 8,000,000 cu ft of casinghead gas from the North Katy field daily.

Construction was begun early in the year also on a casinghead plant at Anahuac to process between 35,000,000 and 40,000,000 cu ft of gas daily and recover 30,000 gal of gasoline. This plant, scheduled for completion by midsummer, will cost about $2,500,000.

Construction was begun early in March, jointly by Humble Oil and Refining Company and Quintana Gas Company, on a $3,000,000 natural gasoline plant in the big Tom O'Connor oil field near Refugio. This plant is designed to recover 36,000 gal of liquid fuel from the 35,000,000 cu ft of casinghead gas to be processed daily when it begins operating late this year.

The Clear Lake Natural Gasoline Plant near Houston was recently completed at a cost of $2,250,000. It will process 50,000,000 cu ft a day of gas and casinghead gas and will recover about 36,000 gal of liquid fuel daily.

This plant will process and recover gasoline from 19,000,000 cu ft of gas from gas wells in the Dickinson and Halls Bayou fields. Prior to the opening of this plant that volume of gas has been produced directly into Humble's Tomball natural gas system lines.

In addition to the natural gas, the plant will handle daily some 31,000,000 cu ft of casinghead or oil well gas from the Dickinson, Gillock, East Clear Lake, and Friendswood oil fields. In the past the oil well gas in these fields has been flared.

Supplementing the Clear Lake plant proper is an 1800-hp compressor plant that Humble built in the Dickinson field to boost to line pressure the oil well gas from the Dickinson and Gillock oil fields. Casinghead gas from these two fields was formerly processed in Humble's Dickinson Gasoline Plant and the residue was vented to the atmosphere.

Personnel required to operate the Clear Lake project includes a booster plant foreman and 10 employes at the Dickinson unit, and a plant superintendent and 17 others employes at the Clear Lake plant proper.

A 12-unit housing section for employes and an office building have been built adjoining the Clear Lake plant. A recreation hall is to be added soon.

Other casinghead gas conservation projects built by Humble in Texas and Louisiana since the war are:

Hawkins (East Texas)	$310,000
Red Fish Reef	16,700
Chalkley (Louisiana)	160,000
Roanoke (Louisiana)	78,000
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Significance of

Atomic energy to petroleum problems

By **J. D. HASEMAN**[1]

● **Introduction.** The rapid and successful development of radio well logging during the last eight years has produced some new data that have revived the question of how, how much, and in what sediments were the radioactive materials originally deposited. It has also renewed the question of what changes have ensued in the relative percentages of the original amounts of radioactive minerals of shales, sandstones, and limestones.

EXCLUSIVE

The results of radio well logging also have revived the question of whether or not there have been sufficient local concentrations of radioactive minerals in the past sediments to affect either the synthesis of petroleum out of plant cellulose or to effect permanent changes in the characters of species of plants and animals that lived in such present and past environments.

If local concentrations of radioactive minerals did change characters of species, then they have significance in the proper correlations of fossils, a factor that is very important in petroleum geology. If they aided in the synthesis of petroleum, they probably have significance both for surveying for new deposits of oil and for the use as catalysts in certain refining practices.

It is more than 30 years since the writer[2] found that there was a direct connection between the synthesis of asphalt and the radioactivity of thorium silicate and cerium phosphate found in his Florida vandyke brown mine. The same was proved by his four years' tests between 1941-1945. These tests were made on No. 4 coal stripper pond plants in loosely sealed jars placed in a dark basement. The jars with only water, plant tissues, and Vero Beach, Florida, black sand yielded heavy hydrocarbons but no carbon dioxide nor methane. The control jar yielded carbon dioxide and methane but no heavy hydrocarbons. Best yields were obtained by adding activated carbon and activated bentonite to the black sand in the same amount of plants in jars containing salt water, sulphur, lime, etc. These tests were turned over with suggestions to the U. S. Peoria Laboratory for their work on making liquid motor fuels from farm waste in 1945.

The wide field and laboratory work of the writer clearly indicated that nature liquefied plant cellulose and precipitated it in shallow brackish water and salt water clastic sediments. Nature then first synthesized heavy hydrocarbons by means of radio and activated energies. How nature then made lighter hydrocarbons from the heavy ones needs further clarification.

In many regions kelp and other sea plants also were source cellulose materials. Bacteria probably were important in the production of liquid humic acid carbohydrates from plant cellulose; but field and laboratory work showed that radioactive thorium silicate and cerium phosphate, activated carbon, activated bentonite, phenol-like humic acids, and sulphur gases prevent destructive bacterial reactions. Whether all bacteria are killed by these materials needs clarification. Hence it now appears that bacteria, plancton, and other one-celled plants played only a minor role in the origin and synthesis of petroleum, except in the Ordovician and older sediments. If they played any role at all, it was probably through their activated carbon content or their enzymes.

It is more than 40 years since the writer began to gather data concerning the distribution of local concentrations of radioactive minerals in existing clastic sediments of geosynclinal areas of North and South America as possible environmental factors affecting the origin and dispersal of species. Part of this field work led to the discovery of how nature activated Fuller's earth between the underground water levels. Some of these naturally activated clays do sometimes have actual radioactivity but they normally work through their production of active H and OH ions by means of their energies of activation. Varying percentages of activated carbon and silicon containing materials are found more or less mixed in local concentrations of radioactive materials such as thorium and cerium.

During 1927-1928 the writer tested mixtures of the activated carbon and activated bentonites as well as Vero Beach, Florida, black sand containing about 1½ per cent thorium silicate and ½ per cent cerium phosphate upon previously bred up pure drysophla gnats. He obtained both constructive and degenerate changes in the characters of species. The destructive changes were caused by the more penetrating hard gamma rays of thorium. The longer and less penetrating rays of the energies of activation and radioactive materials, especially cerium, caused the constructive changes in the characters of drysophla. These tests clearly indicated that the energy yielding materials of environments affected the natural energy-yielding materials of the germplasms of species so that the normal energy levels of their various H and OH ions were changed somewhat like Dr. Labier of Terre Haute, Indiana, and the writer changed the energies of activation of both commercial pepsin and activated bentonite by use of his ultraviolet and X-ray equipment.

Varied tests of the writer clearly indicate that profound changes are long since due in the old concept of catalytic reactions and alleged surface phenomena—especially in all cases of catalytic reactions that ensue at relatively low temperatures and pressures necessary for vital activities. This change of view is necessary in order to understand the colloidal changes invoked by the energies of activation as well as the energies of radioactive materials. Naturally, later data will clarify the reason why so much emphasis must be placed on the energies of activation of both living matter and activated carbons and silicon containing materials.

So even though Roentgen (1895) initiated a revolutionary change in our concept of energy and matter, and even though the discovery of Roentgen rays was followed by Becquerel rays, radium rays, cosmic rays, 42 radioactive minerals, the cyclotron, the betatron, and topped by the atomic bomb, there is still considerable to be learned concerning the true nature and structure of atoms and their bundles of energies in different environments or physical and chemical conditions.

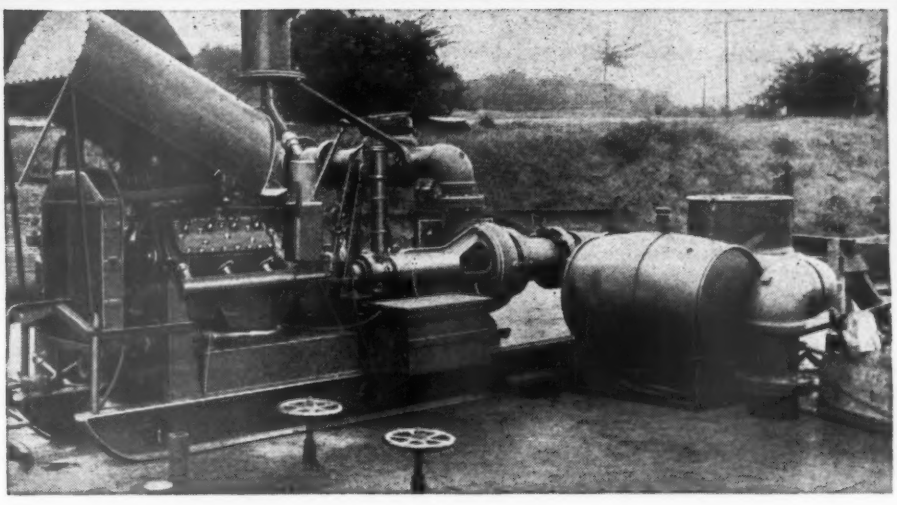
It is becoming more and more apparent that the energies of activation of activated carbon and silicon containing materials are a special phase of atomic energy even though they do not yield the classic alpha and beta phase. (Even radioactive potassium does not produce the alpha particles.) These energies of activation are somewhat like gamma rays. They have, however, longer wave lengths and are much less penetrating than the short, hard gamma rays. They are also much less damaging to living tissues—making constructive rather than degenerative changes. Their length of life can also be shortened by rapid, complete re-use until the activated materials are totally spent.

The true energies of activation, i.e., where no extra heat and pressure are required to produce chemical reactions, are apparently put in the outside of the nucleus of atoms by various natural and artificial processes. Radiant energies in part also come from outside the nucleus

[1]The writer wishes to express his thanks to Dr. Piersol, Bell, and others of Illinois University, and to Dr. Langer, Harmon, Mr. Steve Burger, and others of Indiana University for aid and suggestions.

[2]"Humic Acid Origin of Asphaltum," J. D. Haseman, *A.A.P.G. Bulletin*, 1921.

"— speaking of FORD ENGINE ECONOMY"



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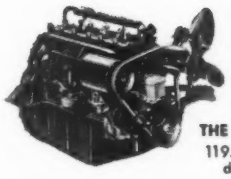

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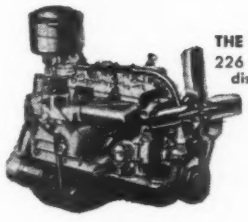

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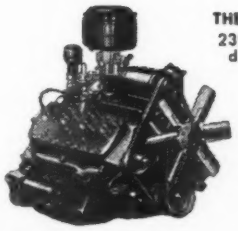

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of atoms as a rule but it is due to the natural transformation of one element into another. The nuclear energy is freed by the so-called explosions of the nucleus of atoms such as in the case of U 235 of the atomic bomb.

The nuclear atomic energy can be brushed off as having little if any past or future direct connection with petroleum problems, because it normally destroys both organic and inorganic matter as evidenced by the explosions of the five atomic bombs. It is dangerous to life. It is much more like the energies of star formations. It probably will continue to be very expensive until man learns how to make some of the more common heavy elements other than uranium and thorium do what nature does with U235. Even radioactive salts and isotopes can possibly all be eventually made more safely and more cheaply by other means.

Consequently, the radiant energy in the form of alpha, beta, and gamma rays emitted by radioactive minerals, and the energies of activation of activated carbon and silicon containing materials have had and probably will continue to have, at least until new basic discoveries are made, much more value and significance to students and engineers dealing with certain petroleum problems than the over highly publicized nuclear energies. They are evidently nature's chief secret connected with both organic and inorganic evolutions on the surface of our earth.

● **Distribution of atomic energy yielding materials in sediments.** *A. Radioactive.* There are 42 radioactive minerals known in such igneous rocks as the granites. These radioactive materials fit into either the uranium, actinium, or thorium series. Their half-life varies widely. This variation is important because the radioactive materials having short half-life may have been very important originally in making petroleum even though no trace can now be found in the older shales, sandstones, and limestones. They also vary much in regard to the hardness or softness of their gamma rays. This has a bearing on several phases of petroleum problems because of the varying penetrability of these rays.

The majority of the long half-life radioactive materials such as uranium, thorium, etc., are heavy minerals. Consequently, they are and were invariably deposited after their erosion from the granites in sand and gravel and never in silt and mud. Even when moved great distances from their original igneous sources, their finer and finer particle sizes, being relatively heavy, are deposited in finer and finer sands.

Traces of radioactive materials are found in almost all soils and sedimentary strata; but the petroleum students are more interested in local geosynclinal concentrations. The writer has seen many natural deposits of black sand with more than twice the thorium and cerium content.

Bullard's[3] article on river and coastal sands of Texas shows several coastal sands and some average river sands with 3 grains of monazite out of 100 grains of sand. This was for average random sand samples. Hence there are doubtless local concentrations with even higher thorium content. The writer's Florida vandyke brown mine had concentrations given in his humic acid origin of asphalt. The Florida and Georgia surveys have given many local concentrations. The writer has seen the same in placers of north Georgia as well as in two glacial gravel deposits in Indiana; also in the huge deposits near the mouth of Rio Doce (Brazil) still being worked by Gordon in 1907. So there can be no longer any doubt about local concentrations of thorium and cerium in sands of many geosynclinal areas.

There is another method of the concentration of radioactive minerals even less known to many geneticists, geologists, and nuclear physicists. It is the enzymatic energy of activation precipitation by certain enzymes of certain plants that make the proper energy level active H and OH ions to precipitate some rare earth minerals—including cerium and traces of thorium and samarium. This process is quite like the special activated carbon that precipitates gold from cyanide solution, or like Fuller's earth precipitates coloring matter in oils, or probably like activated silicon materials precipitates gold in faults to form later quartz gold-bearing veins.

For example, Robinson[4] has shown that the leaves of certain hickory trees growing in the Blue Ridge have fairly high concentration of the cerium and yttrium groups along with some samarium and thorium. In fact, their dry leaf ash content contained as much as 2.5 per cent rare earth minerals. Of course, much of this is not radioactive. The writer has found no evidence that any species of plant or animal could precipitate as much as 3 per cent short and long half-life radioactive minerals. Such high concentrates or contents would produce destructive changes in the tissues.

The actual radioactive content found by Robinson and others in plants would be ample to explain the origin of much of the high radioactive content found in shales such as the high carbon containing shales like the Chattanooga. Land and fresh-water, brackish-water and marine plants with radioactive content would often become mixed in muds and finer silts that later turned into shales. So shales very probably did acquire much of their long half-life radioactive content by means of the energies of activation of activated carbon and possibly silicon containing materials. Some of the radioactive content also could have been acquired by a like precipitation from solution before the mud consolidated. Some of the low specific gravity radioactive materials could have been blown and washed into the original shale mud; and, of course, the potassium content of most shales would have had some radioactive potassium.

We find, therefore, that many sands usually have had higher percentages of directly deposited high specific gravity long half-life radioactive materials than the more or less indirectly plant and water precipited radioactive long half-life materials in muds; but after millions of years, we find through radio well logging that the high penetrating gamma rays are more abundant in shales than in sandstones. So how or why did the shales retain so much of their long half-life radioactive materials whereas the sandstones lost so much of theirs?

Ramsey's[5] papers on radon gases or emissions of cave water may have some facts that will throw some light on the above reversal of percentages of radioactive contents of shales and sandstones. He found that the radon in both the Mississippian caves near Bloomington, Indiana, and the Ordovician caves of southwestern Ohio was much more abundant during high flow than during low flow of cave water. This radon content evidently came from soluble radioactive materials of soils and decaying leaves over crevices and sink holes of the caves.

It seems evident from what Ramsey found that much of the long half-life radioactive minerals could have dissolved and scattered through solution in the water of porous sandstones. In fact, the mere changing of humic acid carbohydrates into liquid petroleum would develop porosity that otherwise would have been impervious to water as was the writer's Florida vandyke brown ore. Likewise these energy yielding materials could actually precipitate many colloids that would eventually tend to eliminate porosity. So the changes of porosity in sandstones evidently had something to do with the removal of local concentrations of long half-life radioactive minerals. No such change would have ensued in most shales because they are much less porous; and their energy of activation content as a rule would have tended to re-precipitate any long half-life radioactive material that might have dissolved. Naturally, the radioactive potassium aluminum silicates would be, as a rule, much less soluble.

It seems to the writer that the high alpha ray from radon content of sandstones found by Bell, Goodman, and Whitehead[6] is best explained by movements of water through the porous sandstones quite like Ramsey found in the caves. There could have been even abnormal water movements in the strata for some time after the well was drilled until drill hole and underground strata pressures were stabilized.

It also seems to the writer that radioactive potassium alone will not explain adequately the high gamma ray content

[3]"Source of Beach and River Sands on Gulf Coast of Texas," Fred M. Bullard, *Bull. Geol. Soc. Amer.*, Vol. 53, 1942.

[4]"The Occurrence of rare earths in plants and soils." W. O. Robinson, *Soil Science*, June, 1943.

[5]R. R. Ramsey, "Radio Active Spring Water," Ind. Acad. Sci. 1914. "Variations of Emissions of Radio Active Spring Water," Ind. Acad. Sci., 1941. "Radioactive Spring Water," *American Jour. Sci.*, September, 1915. "Variations of Emissions of Spring Water," *Phil. Mag.*, December 1915.

[6]"Radioactivity of Sentimentary Rocks and Associated Petroleum," K. G. Bell, C. Goodman, and W. L. Whitehead, *A.A.P.G. Bulletin*, Vol. 24, No. 9, September, 1940, pp. 1536-1538.

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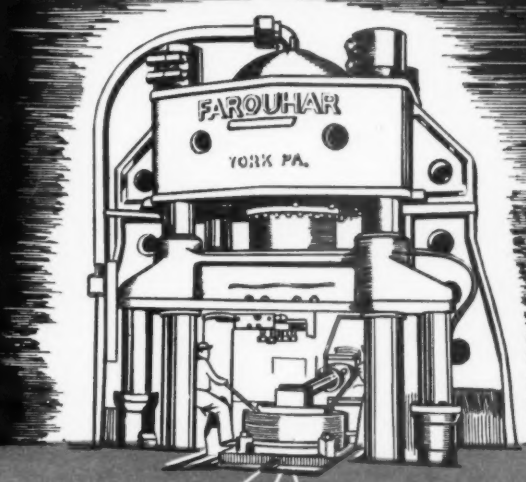

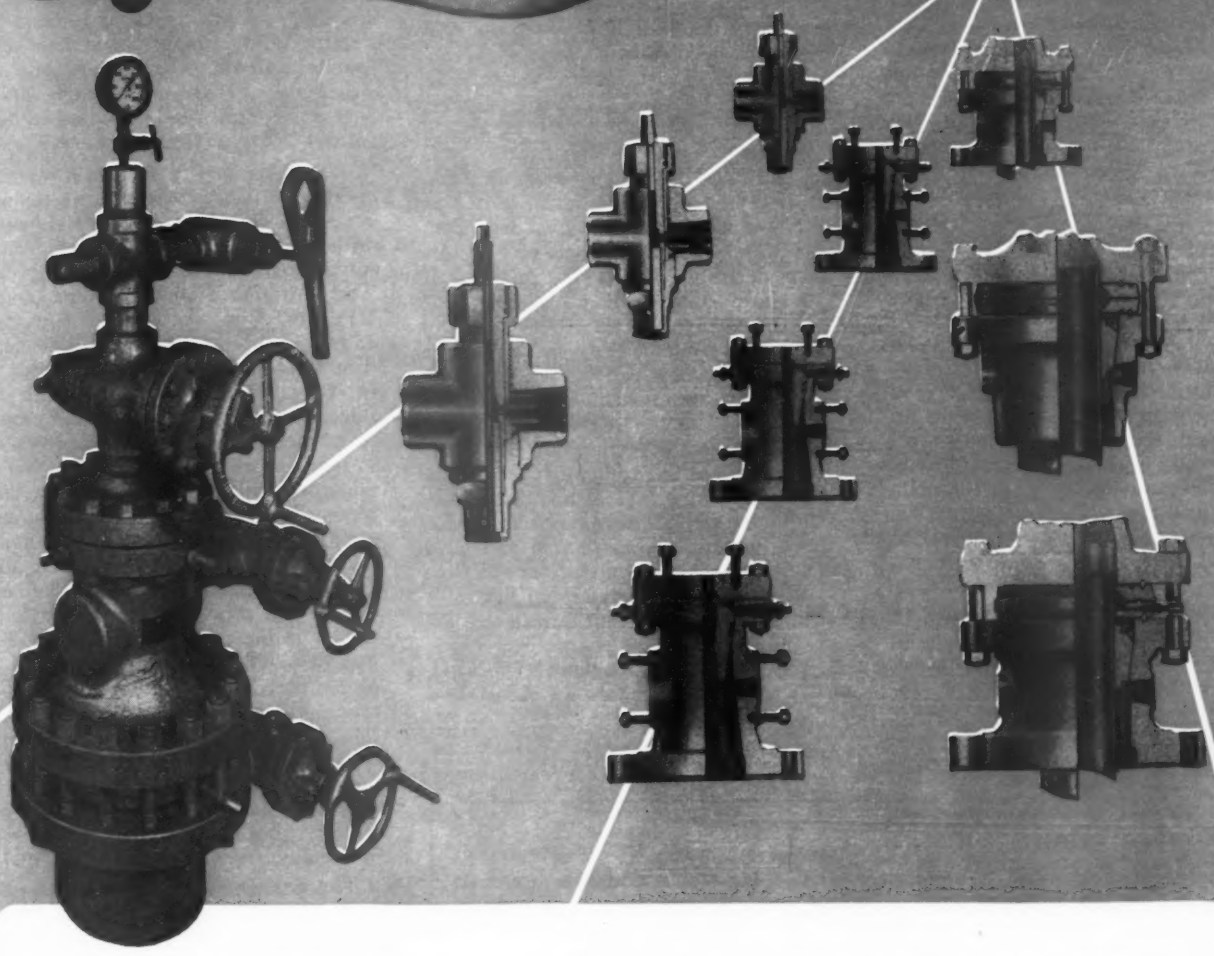

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of such shales as the Chattanooga because of the nature, half-life, and penetrability of the gamma rays of radioactive potassium. In fact, the writer gathered from some of the radioactive experts at both Indiana and Illinois universities that gamma rays would hardly penetrate some concrete and as much as three strings of casing as well as the heavy iron ionization unit. There can be no doubt but that the gamma rays from thorium are much more penetrating and thorium has 10 to 12 times the half-life of potassium.

B. Energies of activation. The energies of activation of activated carbon and silicon containing materials, whatever they may prove actually to be, certainly have a direct bearing on many petroleum problems. They are energies placed and made available in the outer shell of colloidal atoms of silicon and carbon containing materials by specific natural and artificial processes. They do chemical work at relatively low temperatures and pressures, i.e., under conditions necessary to vital activities. They work through the production of their specific H and OH ions by their energies of activation. Activated carbon-containing material in the form of enzymes are essential for the production of source cellulose material.

Activated bentonites, Fuller's earth, silica gel, and activated carbons have a wide use in oil bleaching and several other well known processes. Their energies effect changes in species, destructive bacterial reactions, magnetic readings, discharge of a charged electroscope, and the fission of yeast cells through thin quartz but not through glass. These are but a few of the many unpublished things that the writer has learned about the energies of activation. They had to be studied from results as there was hithertofore no known direct way to study these energies of activation.

The energies of activation and radioactive materials are now known to synthesize hydrocarbons both in the laboratory and in nature. So it seems to the writer that there should be some way devised to be sure of being able to distinguish such hydrocarbons from those alleged to be due to seepages from great depths; and since energy yielding materials would tend to be placed around the edges of the successive strata of slowly rising domes and anticlines, it seems possible that a gamma ray or H ion survey might be devised that would be as valuable as chemical surveys. This field warrants much further research and clarification.

The energies of activation of activated bentonite and carbon may even prove valuable to precipitate the proper radioactive material to prepare catalysts that might produce the proper energy levels for special H and OH ions to do specific chemical work of hydrogenations, hydrolyses and dehydrolyses, oxidations and reductions, and polymerizations at low temperatures and pressures. We can now truly say that noninjurious radiant energy and energies of activation are more than the twilight between the vitalistic and mechanistic concepts of energy and matter. They are variations of the same thing—bundles of energy, time, and space.

C. Radio well logging. Radio well logging[7] has developed so rapidly and has become so valuable for locating tops and bottoms of sands that a brief consideration of the gamma ray results seems desirable. This is especially true if the above consideration of how sands and muds acquired their long half-life radioactive content, and how sandstones lost most of their radioactive materials while shales retained much of theirs is sound. The gamma ray well logs seem to show that the shales now have the greater radioactive content. It is possible but not probable that such shales as the Chattanooga might have kept their radioactive materials precipitated but also might have an unknown factor that slowed down the normal half-life loss of its radioactive content during the last five hundred million years. This vague hunch or possibility needs clarification, as it might develop into an aid for the better storage or pyles of U235 and U239.

Tests with the Schlumberger radio well logging unit (kindly granted and made by Charley Foh at Flora, Illinois,) strongly indicated that Indiana well and outcropping Chattanooga shale had about the same gamma ray content as did the Vero Beach, Florida, black sand with approximately 1½ per cent thorium silicate and ½ per cent cerium phosphate. These tests had to be made outside the well bore, so it was apparently impossible to attain the sensitivity high enough to obtain either positive or negative data concerning the possible effects that the energies of activation of activated carbon and activated bentonite, and active H ions might play in radio well logging; but the effects, if any, appeared to be very little.

Later tests made for comparisons of the same four materials at Indiana University through use of a thin mica geiger counter and aid to Dr. Langer gave even less results. These tests clearly showed that a long statistical count would be required to get anything definite.

The writer finally decided it was more feasible to make these tests by means of a special ionization chamber connected with a delicate electrometer and an induction coil powered by two dry cells. The ionization chamber was made out of thin 1-in. copper pipe about 6 in. long. It had two windows on opposite sides. The windows were ½ in. wide and 1½ in. long. They were sealed with thin mica fastened with plastic and covered with shellac, except the windows. Six 1/16-in. holes were drilled between the windows and covered with thin cellophane. The ends of the tube were stopped up with rubber corks. Each cork had an insulated wire through it so that about ½-in. uncovered wire extended into each end of the tube. One cork also had a tightly fitting petcock so the tube could be evacuated a little at a time and not break the delicate thin windows. Benzene (which has a low 9.6 volts ionization potential) was used four times to remove as much of the original air as possible. The final tube had benzene gas with some humid air at a pressure only slightly above the normal air pressure on the day it was used.

The homemade electrometer was set so that a well-defined meniscus or contact of mercury on 10 per cent sulphuric acid appeared in the fine capillary tube, which was immersed in a bottle of 10 per cent sulphuric acid having some mercury in its bottom for a good contact with a plastic insulated wire. The top of the tube was filled with mercury and could be fastened airtight with a piece of glass tubing, which had a piece of wire sealed in it so that contact could be made with the enclosed mercury and the outside end was fastened with an insulated wire to one end of the ionization tube. The induced current from the coil was fastened to the wire from the mercury in the bottom of the acid bottle and to the other end of the ionization tube. The induced current was set and

[7]Many references are given in "Radio Activity Well Logging" by Robert E. Fearon, *The Oil Weekly*, June 4 and June 11, 1945.

Philippine Island wildcats

The first of a series of three wildcat wells will be spudded this month in the Philippines by Far East Oil Development Company, Inc., a Philippine corporation with headquarters in Manila.

This first well to be known as "Cebu" 1-A will be drilled on the northern tip of the Island of Cebu and has the Basement as its objective unless discovery is made above this point. Basement at this location is believed to be at approximately 12,500 ft. A diesel-driven rotary outfit is now being unloaded at the well site. The work is being constructed by Kern Drilling Corporation of Long Beach.

Kern Drilling Corporation has sent, from California, drillers, one mechanic and one tool pusher to do the work. The crews will be filled up with native labor, which will have to be taught as the work progresses. The drilling crews will erect the 136-ft steel derrick and also dismantle it before each move.

Far East Oil Development Company was drilling a well on the Island of Cebu when the Japs struck at Pearl Harbor. The work on the well was continued until at General McArthur's request it was demolished.

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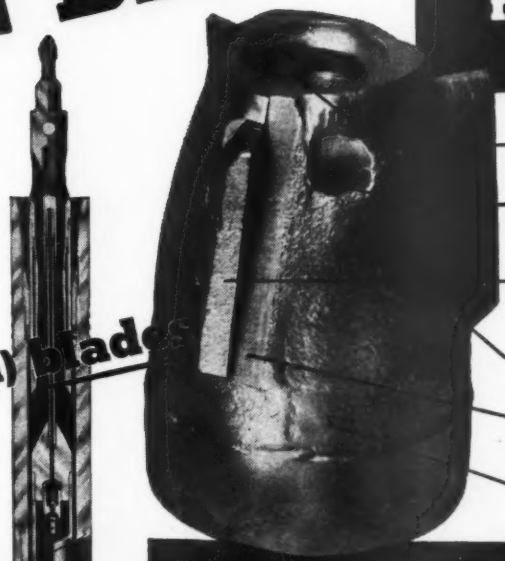

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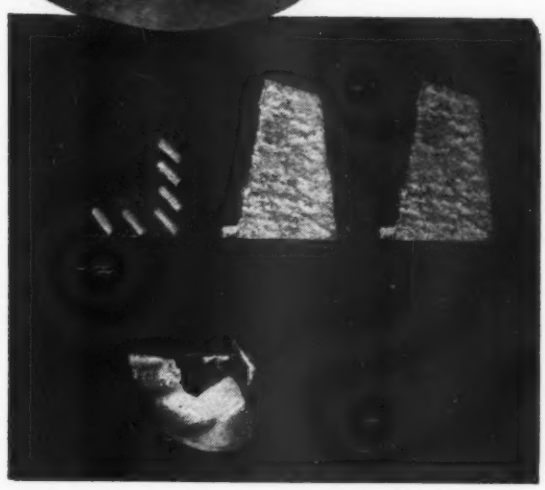

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reset until a sub-minimum would pass through the ionization tube. This was tested several times until the ionization caused at the capillary meniscus did not cause a movement of more than 1/32 in. This average standard automatically took care of the cosmic ray and other local interferences that ruined the tests made by Foy and Langer. Naturally, the writer repeatedly rechecked the standard, which could be easily adjusted by movement of the column of mercury and by change of the induction coil. (Such an electrometer will readily measure the difference in potential made by the energies of activation of the enzymes affiliated with muscular contractions and nerve impulses. Hence, they can be made very delicate—especially when higher magnification is used to read the meniscus movements.)

The windows of the ionization tube were covered with activated bentonite and carbon, Vero Beach black sand, Indiana Chattanooga shale, and commercial pepsin (a gastric enzyme). All these materials caused at least twice or more movement of the meniscus than the standard used or set up for the plain ionization tube. Naturally, the pepsin made less change because years before the writer found that the rate of change of the discharge of a charged electroscope was directly proportional to the pH of the activated material. The standard used was re-read and all the above materials were re-read by both the writer and Steve Burger, assistant to Professor Harmon.

So there no longer can be any doubt that enzymes, activated carbon, and activated bentonite did free energy of activation that did ionize the benzene that did let more current pass to cause the ionization at the meniscus and its movements. So after 20 years the writer has finally found a direct way to prove that the energies of activation free bundles of energy that produce H and OH ions with different energy levels. This view was propounded about 20 years ago from studies of results of energies of activation on various chemical and physical reactions. It is now self-evident from the above results that this discovery will enforce profound changes in the concept of surface chemistry as applied to both vital and inorganic energies of activation.

Even though the above tests with small quantities of activated materials do show that through real thin mica and cellophane windows the energies of activation do ionize benzene mixed with humid air in a closed copper tube, it does not prove that such energies could penetrate the heavy iron ionization chamber used in radio well logging. It is at present the writer's opinion that even if these energies did penetrate some, the effect on the record would probably be very minor for radio well logging. What the combined effect of a thick mass of Chattanooga shale, with its smaller content of carbon and silicon containing material would be, should be further clarified.

The alpha and beta rays of radioactive materials have been widely tested on many types of chemical reactions. They have been used even in certain phases of well logging. Some of these results are valuable. Many of them are not only interesting but promising, but it is true that much more work is needed before any of the radioactive rays acquire their due significance to petroleum problems.

In light of the foregoing, it seems desirable that someone should examine oil sands for the disintegration products of thorium, uranium, cerium, etc., as some of their remains might have been less soluble than their radioactive forebears. It is true that even though some assert that all asphalts do have some radioactivity even saturated oil sands do not now exhibit in any way nearly so much radioactivity as the Chattanooga shales. The oil sands have more or less connate water and are usually surrounded by water. Also, the oil may have migrated a short distance from its original source, etc. So this subject needs further clarification.

Let us hope, therefore, that the near future will reveal many more facts about radio and activated energies so that petroleum engineering in its broadest sense may utilize these energies more fully. May we not now hope that some bright young engineer will invent a cheap mechanical way to make active hydrogens with various energy levels so that lower temperatures and pressures may be used. ★ ★ ★

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Sampling two-phase streams from high pressure condensate wells*

By **DONALD F. KATZ** and **GEORGE GRANGER BROWN**, University of Michigan

PART 2—*Conclusion*

● **Plain tube sampling.** In order to compare the results at Katy and Erath on vertical and horizontal pipe sampling sections it is necessary to express the flow rates and tip positions as a function of the diameter of the sampling section. since four sizes of pipe (0.599, 1.689, 1.735, and 3.438 in. diam.) were used in the Katy tests and only one size (2.0 in. diam.) was used in the Erath tests. The tip position is expressed in terms of the number of pipe diameters equal to the distance the tip is downstream from the nearest disturbance, and the flow rate is expressed in terms of millions of standard cubic feet of gas per day per inch of internal diameter of pipe.

The Reynolds number for a fluid flowing through a pipe is the best criterion for expressing the turbulence of a fluid stream. The Reynolds number varies directly as the diameter of the pipe and as the mass flow velocity. For this reason the total flow rate through the sampling section is divided by the diameter of the pipe to express quotient which would be proportional to the Reynolds number. Therefore, flow rate in millions of cubic feet per day per inch of pipe diameter appears to be a sound basis of comparison for the velocities which would present similar sampling conditions. Comparison of the results on the sampling sections of different diameters also confirmed this theoretical conclusion.

All of the five conclusions based on the Katy tests (page 52, reference 5) have been confirmed by the results obtained at Erath except number 2, which is repeated here because of its importance.

"II. It appears that thin walled sharp tips may give a representative sample if used at a constant velocity ratio of about 0.94 at liquid content from 0 to well in excess of 10 per cent by volume (6.62 gal. per M. (GPM) at 1500 lb per sq in.) in either horizontal or vertical sample lines provided there is a minimum straight section of about 40 diameters in length upstream of the tip and about 15 diameters downstream, and the velocity in the sampling section is sufficient to develop the required degree of turbulence."

Several vertical sections varying from 1.5 to 3.5 in. I.D. were tested. Fig. 19 shows one of the 2-in. I. D. vertical sections tested at Erath. Fig. 20 gives velocity ratio-correction factor curves obtained using straight taper tips in this section.

Although no data for different liquid contents were obtainable at Erath, the data taken at Erath at about 1 gal. per M. liquid content are in excellent agreement with the data taken at Katy under corresponding conditions. This comparison can be made best by a plot of the Katy and Erath data showing the velocity ratio for the correct sample as a function of liquid content expressed as gal. per M. in the flowing stream. This has been done in Fig. 21, which includes all the data on sampling in a vertical section with a blunt tip. All of these data were obtained at a tip position of 42 pipe diameters and at a sufficiently high flow rate so that flow rate is not a variable affecting the velocity ratio of the correct sample. The data on the blunt tip obtained at Katy are in excellent agreement with the single test series made at Erath with a blunt tip. The lower curve in Fig. 21 representing the data obtained with a blunt tip indicates the sensitivity of blunt tips to the liquid content in the sampling section.

Data in the Katy report[7a, 9] taken with sharp tips inserted and centered in the well tubing are also plotted on Fig. 19 as X's and indicate that the liquid content at least up to 3.5 gal. per M. had no effect upon the velocity ratio for the correct sample when sharp tips were used. Unfortunately the Katy tests were interrupted before a complete series could be run on the vertical sampling section with sharp tips positioned at 42 pipe diameters. However, the results at Erath with a liquid content of about 1 gal. per M., using the same type of tip at 42 pipe diameters are in excellent agreement with these independent data from the Katy tests.

Although the effect of liquid content was not studied independently at Erath the agreement between the Katy and Erath data confirms the accuracy of the limited data obtained at Katy and strengthens the conclusions derived therefrom that the sharp tips give results that are independent of liquid content.

The data obtained on the 4 in. (3.48 in. I.D.). vertical sampling section at Katy include flow rates from about 3.7 to 11.8 million cu. ft. per day corresponding to 1.1 to 3.31 million cu. ft. per in. of pipe diam. and liquid contents up to 12.8 gal. per M. in the sampling section, but only at tip positions of about 20 pipe diameters. Although these conditions are now considered not to be the most satisfactory for sampling, (see Fig. 11) the data as plotted in Fig. 22 are useful as a further indiciation that the velocity ratio for correct sampling with sharp tips is independent of the liquid content.

The tip position of 20.7 pipe diameters represented by the data on Fig. 22 corresponds to a tip position of about 3½ ft. in a 2-in. pipe. Referring to Fig. 11 it is seen that the velocity ratio for correct sampling at the 3½ ft. tip position (20.7 pipe diameter) is about 0.72 and much less than 0.95 at the 9-ft. position (54 pipe diameters).

The minimum flow rate required to develop the necessary degree of turbulence to make the method insensitive to flow rate as is desired for satisfactory sampling may be estimated from the data obtained at Katy and Erath. The lower the sampling pressure the greater is the minimum flow rate required. At about 1300 lb. pressure a flow rate of at least 5,000,000 cu. ft. seems necessary for the correct sample to be obtained in a vertical sampling section of 2 in. I.D. at a velocity ratio of 0.94. This corresponds to a minimum of 2.5 million cu. ft. per inch of pipe diameter at 1300 lb. Tests at 1300 lb. per sq. in. and 1,500,000 cu. ft. per in. of pipe diameter[8], and at 1400 lb. per sq. in. and 1.08 million cu. ft. per in. of pipe diameter [7a] required a velocity ratio much less than 0.94 for correct sampling. At these low flow rates and pressures the correct velocity ratio is dependent upon flow rates. At somewhat higher pressures running from about 1500 to 1700 lb. per sq. in. a flow rate of about 5,000,000 cu. ft. per day in a pipe of 3.4 in. I.D. was reported to be the minimum rate that would give consistent results within about plus or minus 2 per cent[7a]. This corresponds to about 1.5 million cu. ft. per inch of pipe diameter, and indicates that this is probably the minimum flow rate at which the correct sample can be obtained at 0.94 velocity ratio at pressures of about 1700 lb. or upward.

These statements should not be interpreted to mean that it is impossible to obtain satisfactory results at lower flow rates. For example in Fig. 22 the four points taken with a flow rate corresponding to 1.1 million cu. ft. per inch of pipe diameter gave the correct sample at a velocity ratio of 0.92, in all cases except one. However at these lower flow rates the velocity ratio required for the correct

*Presented before Natural Gasoline Association of America, Dallas, Texas, April 18, 1946.

[7a]See Part 1, published March, 1947.

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sample changes with flow rate and therefore unreliable results may be obtained particularly at lower pressures.

Several horizontal sampling sections were used and many samples were taken to determine the minimum flow rate for reliable sampling in this position. Fig. 23 is one of the horizontal sections tested at Erath. In the horizontal position the effect of gravity is to tend to cause the liquid to flow along the bottom of the pipe. At low velocities where turbulence is not sufficient to overcome the effect of gravity the liquid content at the center of the pipe decreases at increasing distances down stream from the last disturbance. Accordingly the velocity ratio for the correct sample will steadily decrease as the tip is moved farther downstream from the last disturbance under low flow velocities.

This observation is borne out by the data plotted in Fig. 24. These data were obtained in the horizontal sampling section shown in Fig. 23 which includes a ¾-in. choke at the upstream end of the horizontal section.

At high flow rates the effect of turbulence tends to overcome the effect of gravity and the variation in liquid distribution with distance downstream from the disturbance becomes of much less significance and it is possible to obtain a correct sample at a reasonably high velocity ratio over a relatively long distance of the sampling section. This condition is indicated by the data plotted in Fig. 25.

The results with the blunt tip in a horizontal sampling section of 0.599 in. I.D.[7a] are shown on Fig. 26 for the tip position of 43 pipe diameters. These data were taken at flow rates of about 4.8 million cu. ft. per day corresponding to about 8,000,000 cu. ft. per inch of pipe diameter. At these high flow rates through small fittings and small sampling sections, the total pressure drop amounted to about 120 lb per sq in. This flow rate is at the same velocity as would result from flowing about 53,000,000 cu. ft. through a sampling section of 2 in. I.D., and indicates that a 2-in. I.D. sampling section may be used at flow rates up to at least 50 million cu. ft. per day if a pressure drop of about 120 lb. per sq. in. can be tolerated.

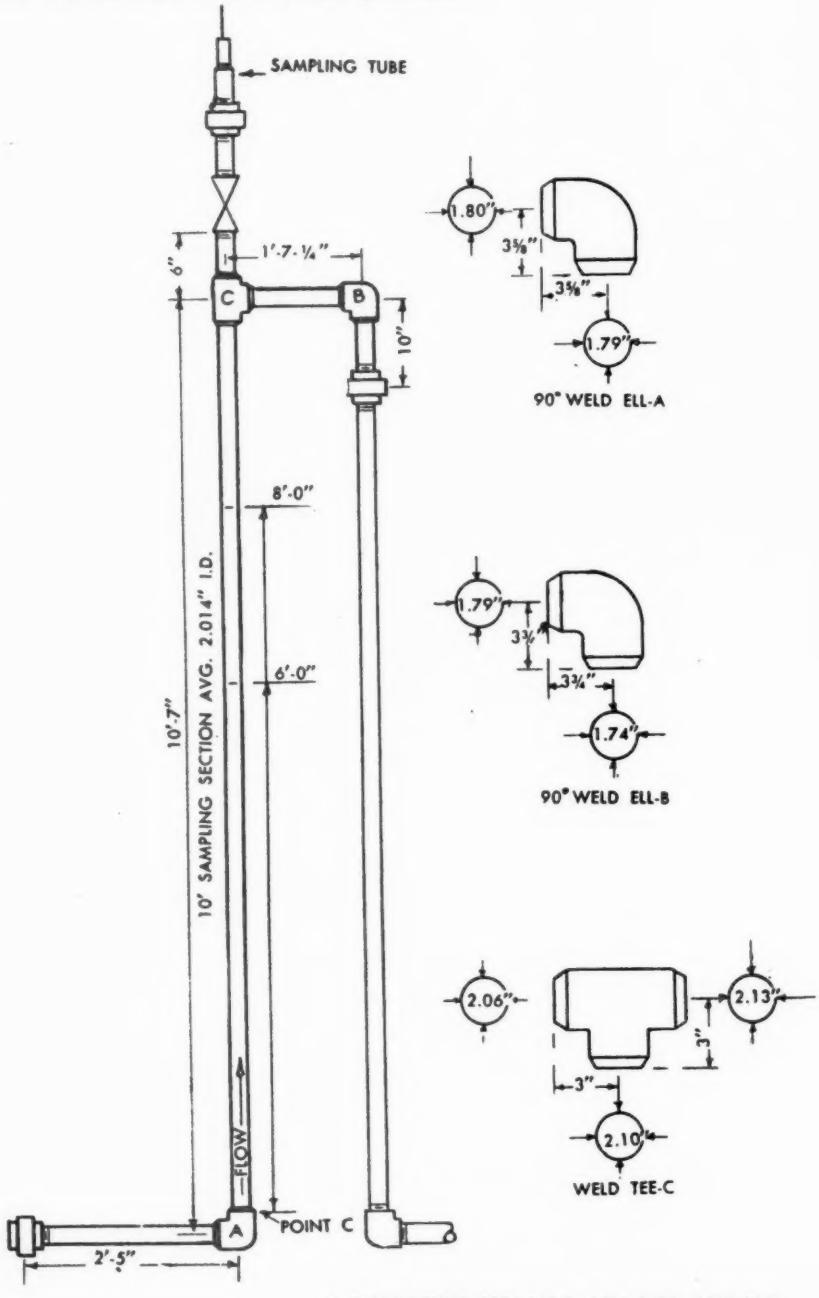
Additional results with a blunt tip at 50.5 pipe diameters in a horizontal section of 1.735 in. I.D. are also plotted in Fig. 26, representing all the data reported as reliable[7a]. These data were taken with flow rates of not less than 4,000,000 cu. ft. per day, corresponding to 2.3 million cu. ft. per inch of pipe diameter, and are consistent with the data taken on the smaller pipe.

The data taken with a sharp edged tip of 0.1622 in. diameter in the Katy test in the sampling section of 1.735 in. I.D. with a tip position of 45 pipe diameters are also plotted in Fig. 24 and indicate that a correct sample will be obtained by the sharp tip at a velocity ratio of 0.94 for liquid contents up to at least 4 gal. per M. These data were taken at flow rates of 5.6 and 11.8 million cu. ft. per day[7a]. These flow rates correspond to about 3.3 and 7.0 million cu. ft. per inch of pipe diameter, which are sufficiently high to eliminate the effect of flow rates.

The tests at Erath using straight tapered tips in a horizontal section of 2 in. I.D. are plotted in Fig. 26 as △ indicate that with the tip at the 7.5 ft. position (45 pipe diameters) a satisfactory sample would be obtained whenever the flow rate was not less than about 6,000,000 cu. ft. per day (3,000,000 cu. ft. per in. of pipe diameter) at about 2000 lb. per sq. in.

● **Discussion.** In all of the data reported from the tests at Katy and Erath the values for gal. per M. represent the actual liquid phase present in gallons per thousand standard cubic feet of gas. These values of gal. per M. are not the total recoverable liquid hydrocarbons present but simply the actual liquid present under the conditions indicated. The total recoverable liquid hydrocarbons will in all cases be greater than the reported gal. per M. in these tests. For example the total recoverable butane plus from the gas used at Erath amounts to 1.8 gal. per M. while the actual content under sampling conditions varied from about 0.7 to 1.0 gal. per M. Accordingly an error of 4 per cent in sampling when the sample separator is operating at about the same pressure as that of the sampling section, means an error of 4 per cent on 0.7 gal. per M. or 0.028 gal. per M. Figured on the total liquid recoverable at 1.8 gal. per M. this means an error of 0.028 divided by 1.8 or 1.5 per cent. This represents the accuracy with which the total recoverable

FIG. 19. Welded 10-ft vertical sampling section.



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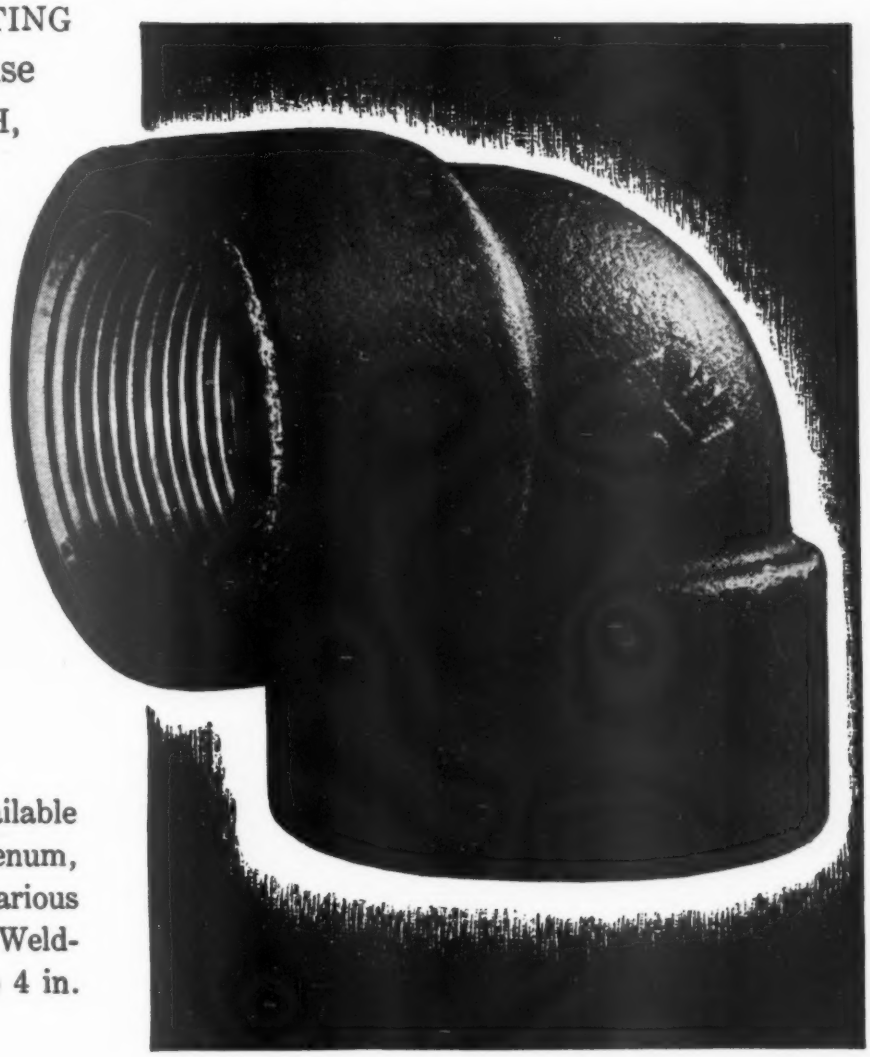

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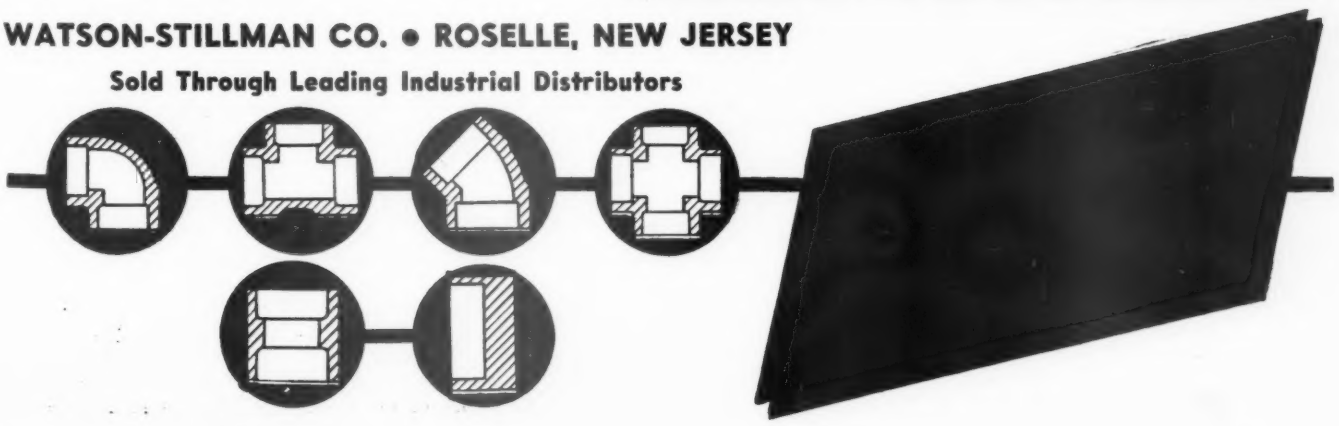


FIG. 20. Welded vertical section tip 8 ft from ell.

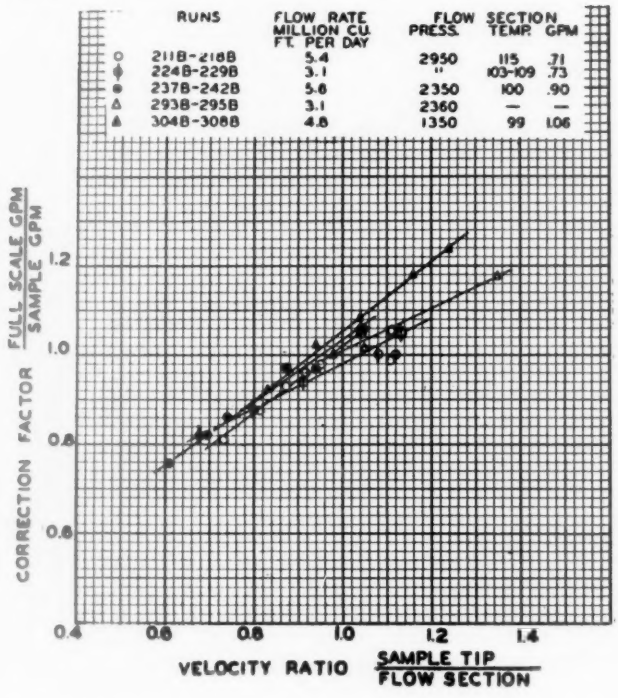
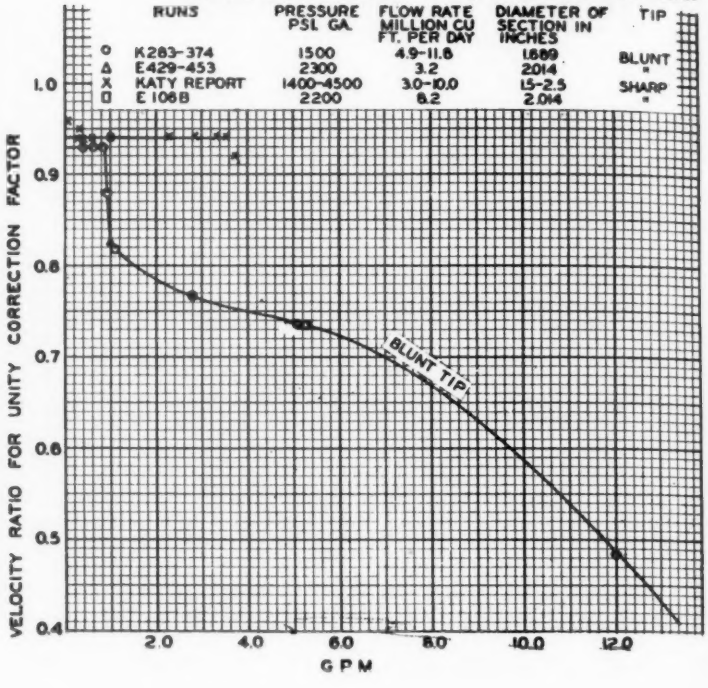


FIG. 21. Comparison of Katy and Erath data on vertical sampling section. Tip at 42 pipe diameters.



liquid would be determined although the accuracy of the sampling of the two phase stream is ± 4 per cent for the conditions indicated.

In the Katy tests the separators were operated at about 830 lb. per sq. in. and 100° F. These conditions correspond to about twice the actual liquid in the separator as that which was present in the sampling section. This increase in liquid in the sample as its pressure is reduced from that in the sampling section to the 830 lb. per sq. in. in the separator comes entirely from the gas phase. Since the gas phase is sampled without error regardless of the velocity ratio, approximately half of the liquid in the separator is free from all error. The error based on the liquid in the separator at Katy for the well stream is therefore one-half the error in sampling the two phase stream in the sampling section. Therefore the criterion for satisfactory sampling at Katy (± 2 per cent of the separator gal. per M.) is equivalent to an error of about ± 4 per cent in sampling the liquid in the two phase stream in the sampling section.

At Erath the separators were operated approximately at the same pressure as in the sampling section and the error in separator gal. per M. is approximately the same as the error in sampling the liquid of the two phase flowing stream.

All the data on all straight pipe sampling sections including the results on sampling in the well tubing [9, 7A], the tests using similar sharp tips 45 diameters downstream from the last disturbance in a horizontal sampling section[7A] and all the data obtained in vertical or horizontal sampling sections in the Erath tests using sharp or straight tapered tips at a position of 45 pipe diameters in a section not less than 60 diameters in length, indicate that the sample obtained will yield the correct gal. per M. actually present in the sampling section within ± 10 per cent when following the suggested procedure using a sampling velocity ratio of 0.94 if the flow rate is not less than the minimum required for adequate turbulence under the sampling conditions.

A procedure has been outlined for sampling two phase streams in plain straight pipe in the vertical or horizontal position using a velocity ratio of 0.94. Various line samplers may be used to obtain reliable results when properly calibrated. The correct velocity ratio in the line sampler will not normally be the same as that in the straight pipe, and the pressure drop through the line sampler will always be greater than through a straight pipe section. For the packed line sampler C, the correct velocity ratio was found to be 0.85, and the pressure drop ran as high as 470 lb. with rivet packing when flowing about 7,000,000 cu. ft. per day.

Whenever it is important to sample with a minimum pressure drop, the use of a straight pipe section is indicated of suitable diameter. When high pressure drop can be tolerated and a short sampling section is desired, a line sampler, or a small diameter pipe section is indicated.

In all of this discussion on sampling of a two phase stream, the liquid phase is considered to be primarily hydrocarbon. The comments and conclusions do not necessarily apply to stream containing substantial quantities of water.

● **Suggested procedure for sampling in straight pipe.** The agreement among all of the tests run either in well tubings, or at Katy, or at Erath indicate that the methods used will give identical results in different equipment of different sizes provided the following procedure is used.

1. Straight pipe sampling section.
   (a) Length 60 diameters or more
   (b) Inside diameter must be known and the tubing should be clean, smooth and straight.
   (c) The recommended minimum flow rate per inch of pipe diameter, and the corresponding maximum pipe diameter per million cubic feet of flow rate are given in Table 2.
   (d) In vertical sampling sections the tip position should be not less than 45 pipe diameters downstream from the last disturbance with 15 diameters of the straight section continued downstream from the tip. The flow rate should be not less than that indicated in Table 2 for a velocity ratio of 0.94.
   (e) In horizontal straight tube sampling section, the tip should be placed at approximately 45 di-

TABLE 2. Minimum flow rates and maximum pipe diameters for plain tube sampling with a velocity ratio of 0.94.

Pressure not less than (lb. per sq. in.)	Minimum flow rate, MM. cu. ft. per in. pipe diameter		Maximum pipe diameter in inches per MM. cu. ft. of flow rate	
	Vertical	Horizontal	Vertical	Horizontal
1200	2.5	4.3	0.4	0.23
1800	1.7		0.6	
2200	1.5	3.0	0.66	0.33

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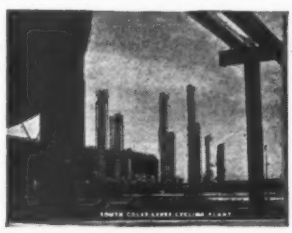

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FIG. 22. Effect of GPM on velocity ratio for unity correction factor-Katy data in 3.48-in. I.D. vertical pipe with sharp tip.

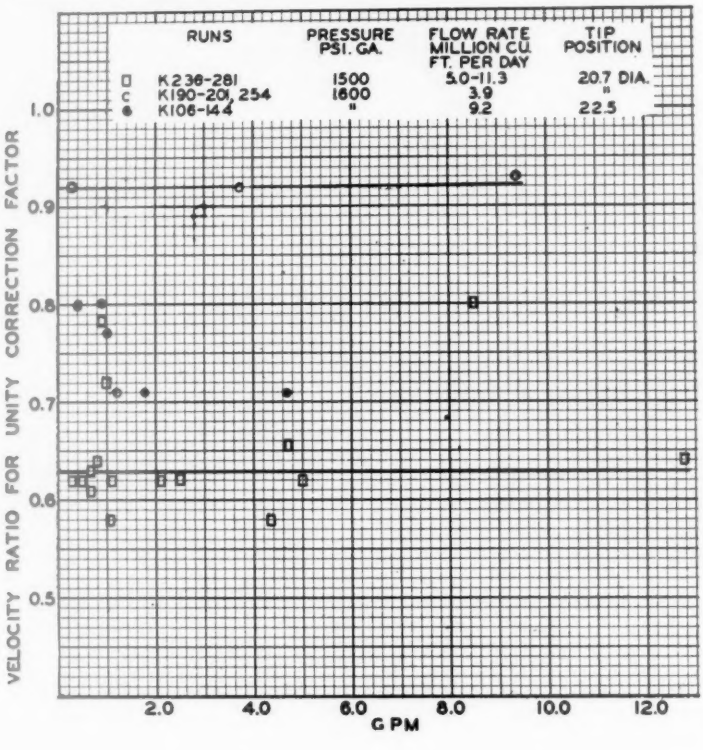


FIG. 24. Runs 41B-54B.

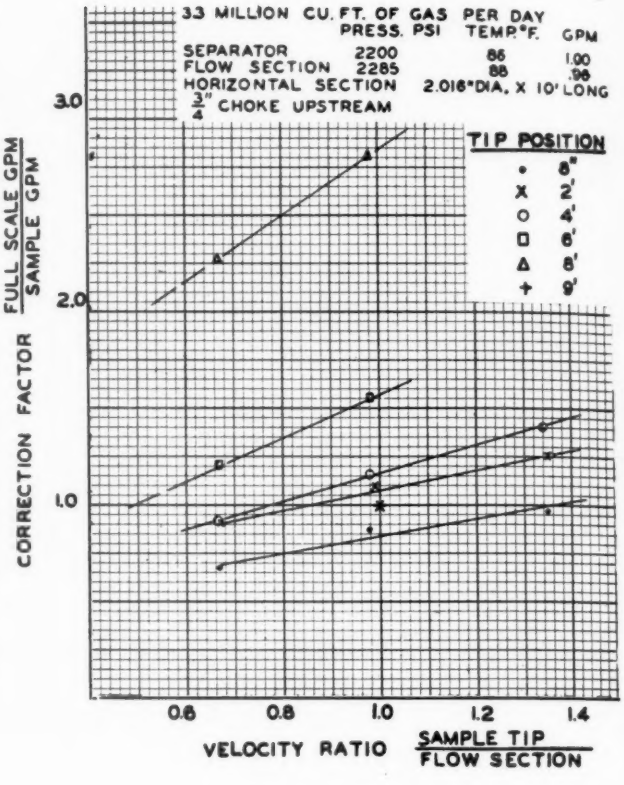
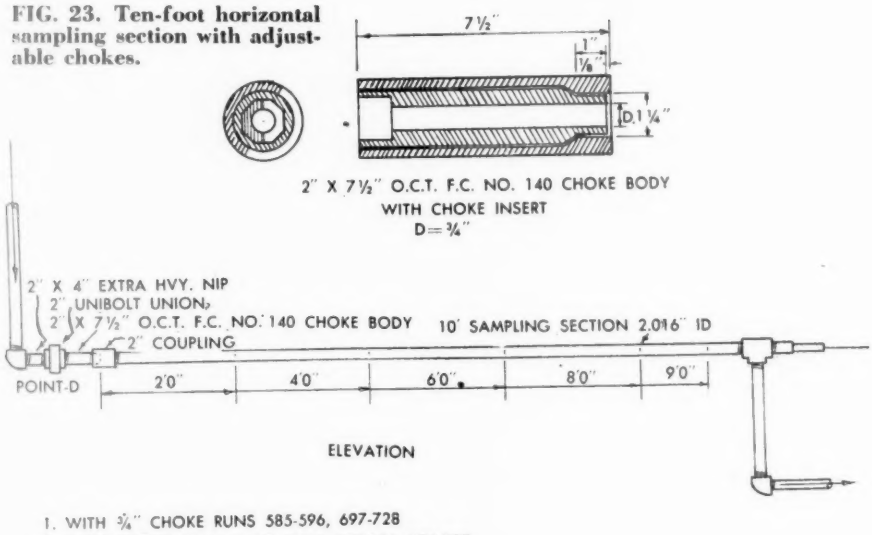


FIG. 23. Ten-foot horizontal sampling section with adjustable chokes.



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ameters downstream from the last disturbance in a straight sampling section of at least 60 pipe diameters in length, and flow rate should be not less than that indicated in Table 2 for a velocity ratio of 0.94.

2. Tips
   (a) Sharp edge tips of the type shown in Fig. 10 (of the proceedings of the Annual Meeting NGAA, page 51, 1944,) or the equivalent.
   (b) The sample tube supporting the tip and connecting the sample to the sample separator should be of the minimum consistent diameter.
   (c) The tips should be well centered by a sturdy centering device or spider downstream from the tip.
   (d) Tips can be permanently fixed in sample sections or inserted by any suitable means provided its position is known and controlled.
   (e) Size of the tip should be, preferably, not less than ⅛ in. I.D. and generally as large as is practical and still bracket the velocity ratio of 0.94 without exceeding the capacity of the small scale separator.
3. Sample separator.
   (a) Must be so designed as to give complete separation of gas from the liquid under the conditions of use.
   (b) The gas handling capacity must be at least adequate to handle the maximum flow rates with a tip not less than ⅛ in. I.D. The gas sampling rates given in Table 3 are required for a velocity ratio of 0.94.
   (c) Must have liquid capacity sufficient to handle the liquid accompanying the maximum flow rate on the richest stream, and give an accumulation time of at least five minutes. It should also

TABLE 3. Sample gas capacity, cu ft per hr.

Tip size, in.		0.125 (8/64)	0.157 (10/64)	0.189 (12/64)
Well flow rate				
MM. cu. ft. per day	M. cu. ft. per hr.			
		1.00 in. I. D.	Sample section	
2.0	83	1222	1930	
5.0	208	3045	4820	
10.0	416	6110	10260	
		2.00 in. I. D.	Sample section	
3.0	125	459	724	1050
5.0	208	764	1200	1750
10.0	416	1528	2400	3500
20.0	832	3056	4800	7000

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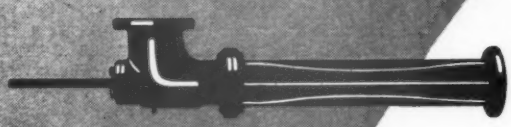

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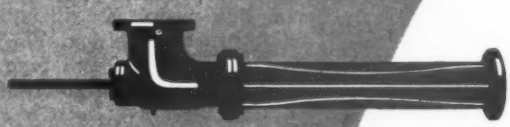

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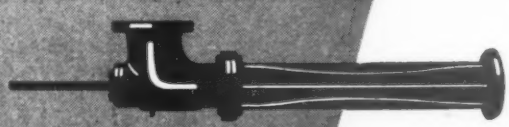

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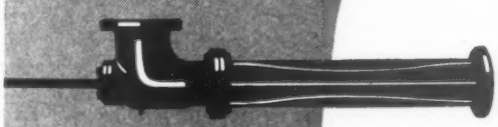

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FIG. 25. Runs 633-654.

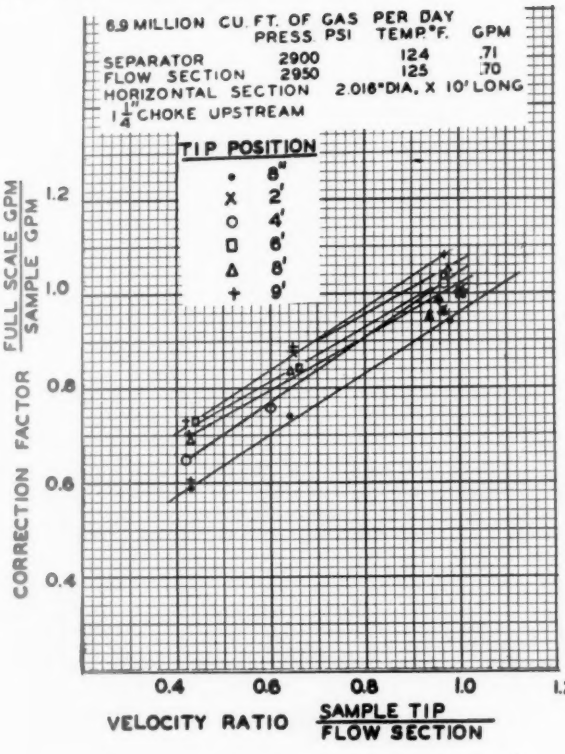
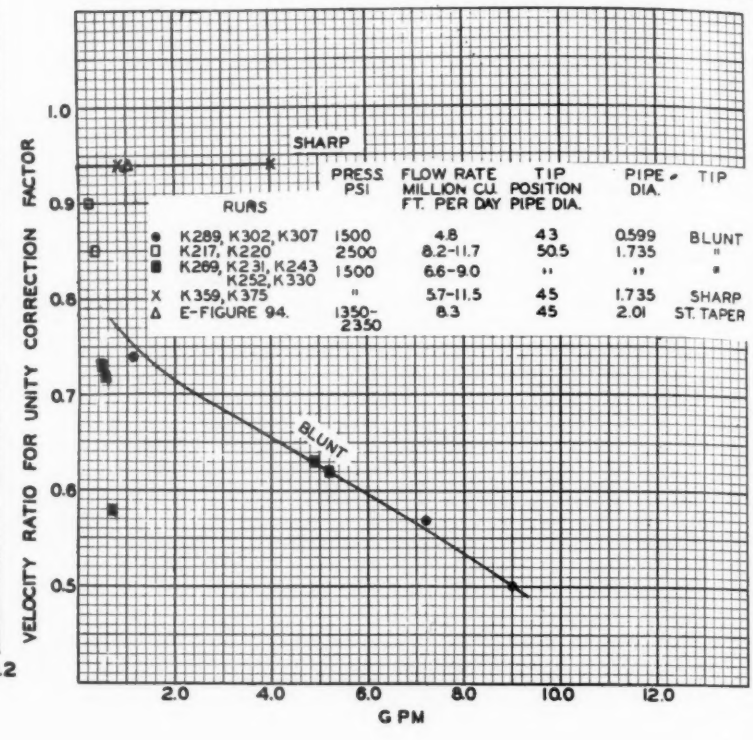


FIG. 26. Effect of GPM on velocity ratio for unity correction factor in horizontal sampling sections with sharp tips and blunt tips.


SHARP
BLUNT
RUNS
PRESS PSI
FLOW RATE MILLION CU. FT. PER DAY
TIP POSITION PIPE DIA.
PIPE DIA.
TIP
K289, K302, K307 1500 4.8 4.3 0.599 BLUNT
K217, K220 2500 8.2-11.7 50.5 1.735 "
K269, K231, K243, K252, K330 1500 6.6-9.0 " " "
K359, K375 " 5.7-11.5 4.5 1.735 SHARP
E-FIGURE 94. 1350-2350 8.3 4.5 2.01 ST. TAPER
VELOCITY RATIO FOR UNITY CORRECTION FACTOR
G PM

be designed to permit accurate readings to be taken at intervals of not less than 15 minutes on the leanest sample to be taken with a gas sample rate well below the maximum capacity of the separator.

Sample gas rate, cu. ft. per hr.	500	1000	5000
Gal. per M. in separator	cc. liquid in 5 min.	cc. liquid in 5 min.	cc. liquid in 5 min.
0.2	31	63	315
0.4	63	126	630
0.6	94	189	945
0.8	126	252	1260
1.0	157	315	1575
1.5	236	472	2360
2.0	315	630	3150
3.0	472	945	4725
4.0	630	1260	6300

(d) Separator must be equipped with means for controlling its temperature and pressure under flow conditions and suitable and reliable means for measuring the gas flow. The combination of an integrating flow meter to give the total gas flow with an orifice to indicate the instantaneous flow rate, or an orifice gas meter alone is satisfactory.

(e) The sample should be brought to the temperature and pressure of the separator before it is introduced into the separator so that it enters the separator at the same conditions that are maintained therein. If necessary this means the supplying of a preheater to the gas sample so that upon expansion it is at the temperature and pressure of the separator.

● **Use of line samplers.** In plain tube sampling the length of the sampling section may be decreased and the tip located nearer the last disturbance, but the velocity ratio for the correct sample does not then remain at 0.94 and usually becomes more sensitive to flow rate. When using various line samplers the tip may be located close to the disturbance, and satisfactory results can be obtained when the devices are properly calibrated. For example, packed line sampler C (Fig. 14) tested at Erath, having a net length of about 5 ft. was found to give approximately the same results as the 2-in. vertical section 10 ft. high, except that the velocity ratio for the correct sample was 0.85 for the line sampler compared with 0.94 for the plain tube, and the pressure drop through the line sampler ran as high as 470 lb. with rivet packing when flowing about 7.2 million cu. ft. per day at about 1510 lb. pressure. At Katy a plain tube sampling section 0.6 in. I.D. and only 3-ft. in length was found capable of passing 5,000,000 cu. ft. per day at a pressure of 1400 lb. per sq. in. with a pressure drop of only 120 lb. per sq. in. A 1-in. I.D. tube would have to be only 5 ft. in length and could handle up to 10,000,000 cu. ft. per day with less pressure drop than required of the 5 ft. packed sampler at 7.2 million cu. ft. per day.

Line sampler A was about 40 in. in length, and line sampler B about 30 in. in length. These samplers showed pressure drops up to about 50 and 380 lb. per sq. in., respectively, and were calibrated over limited conditions as indicated in the paper with an accuracy comparable to that of a straight pipe section.

● **Conclusions.** Suitable conditions for sampling a mixed stream have been determined and stated for straight pipe sampling sections in either the vertical or horizontal position. The minimum flow rate or maximum pipe diameters required to give satisfactory results have been indicated as a function of flow rate and flow pressures.

All the available data indicate that the specified sampling conditions will give reliable results for liquid contents up to 12 gal. per M. However, these conclusions for gal. per M. above 1.1 are based on a very few tests which should be made to remove any doubt concerning this point.

Although the effect of liquid content on the velocity ratio for correct sampling can be taken into account in a practical sampling procedure, the greater simplicity in operating a device which gives the correct result independent of liquid content makes it highly desirable to explore this situation thoroughly.

Tests so far conducted indicate that various line samplers can be calibrated to give results comparable to a properly calibrated straight pipe sampling section. Provided such line samplers are properly calibrated it appears that it is mainly a matter of personal preference whether a straight pipe sampling section or a line sampler be used.

A suggested procedure and a table of minimum flow rates have been prepared for the guidance of anyone wishing to sample a mixed stream in a straight pipe sampling section.

★ ★ ★

(This is the second and last part of the article by Katz and Brown. Part 1 was published March, 1947.)

INCIDENTS FROM SMITHway PRESSURE VESSEL RESEARCH

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Corrosion-resistant Smithlining can now be done with 21 different alloys

WHEN corrosion resistance first became important to the petro-chemical industry, Project No. 71,074 was started to develop a relatively low cost method of satisfactorily lining carbon-steel pressure vessels with a corrosion-resistant alloy.

Project 71,074 resulted in *Smithlining,* a patented process of resistance-welding sheets of alloy steels to a variety of steel base plates, and then forming into segments, cylinders, cones, or heads.

But Project 71,074 has never been closed out. It is still active. To date, it has made practical the use of 21 different alloys as linings. It has no size limitation. It provides for uniform alloy thickness to normal sheet tolerances, and permits two-surface inspection of both lining and base plates as well as chemical analysis and gauging of both.

Finally, it has permitted the successful application of lined vessels to a growing variety of corrosive services.

This unique combination of advantages gives Smithlining unusual appeal to all concerned with corrosive processing.

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Proper care of wire line increases life

By **E. McDANIEL,** *Drilling Superintendent,*
Parker Drilling Company

EXCLUSIVE

MUCH longer wire line life on rotary drilling operations is being obtained by operators who follow a few well known rules. The type of job has a great deal to do with the rope life, but a 6000-ft 1¼-in. preformed, wire-center, improved plow steel line should on the average, make from 40 to 50 trips with proper care.

● **Installation of a new line.** In putting on a new line, it is customary to place the reel 150 ft or more from the derrick and feed the line over the ground to the derrick floor and the drum.

As the new line comes to the job fully lubricated, the greasy surface usually collects a large amount of sand and fine gravel that become worked into the rope on the drum. These abrasive particles may cut the life of the rope by as much as half, and at least by 25 per cent, in the writer's opinion.

Sheave grooves are cut out in much shorter time when the rope is fed to the drum over sandy ground, and this adds to the wear on the wire line.

To prevent the line from picking up these abrasive particles, a steel plate may be paid from the reel to the derrick. This plate should be lubricated lightly with a hard grease. Our plates are 5 ft wide and made of ¼-in. boiler plate. They are in 10-ft sections with one end beveled so that the runway is absolutely smooth from the reel to the derrick.

After the runway has been set, we clean the surface of the plates and apply the grease with a long-handled swab. After the drum has been run, the plates are cleaned with kerosine and stored. We have used the same plates for 10 years.

We have used a wooden runway, but the surface becomes rough in a short time, and it is much harder to clean.

Considering present day rope costs, and the fact that it takes from 4 to 6 hr to change ropes, it is obvious that careful installation is profitable.

● **Lubrication.** After many years' experience, the writer is convinced that regular cleaning and lubricating with special wire line grease increases the life of drilling lines.

On rotary drilling operations, we have adopted the practice of lubricating the lines every 10 days. This practice alone is credited with adding from 10 to 20 per cent to the life of the lines.

We have used a number of different methods of applying the lubricant. At present we are using a gravity drip system at the drum.

Ropes that are removed from the drum, either to be retired or put in storage for later use, are first cleaned and then treated with a storage dressing. For this lubrication we use a hot bath method and a commercial preservative that tends to keep out moisture and minimize the danger of acid damage.

Before using such a rope again, it is cleaned with a commercial cleaner and given a light lubrication. We also use the hot bath method for this lubrication.

The proper lubrication of retired ropes accounts for a considerable gain in the additional usefulness of our lines, and we believe that in any type of drilling operation, the time required and the cost of the lubricant are profitably spent.

● **Rules for cutting back and changing ends.** In rotary operations, beginning with a 2500-ft line on a 136-ft derrick and using 1350 ft to string the blocks, we cut back 75 to 125 ft on the drum end after each 10 trips, and change ends after every five cut backs.

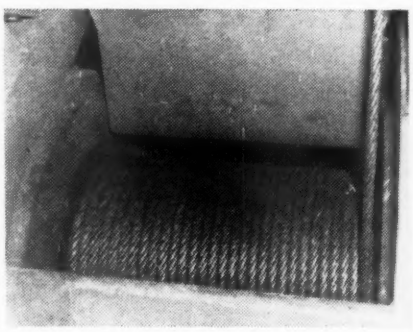
When using a hemp center and drilling at 7000 to 8000 ft, however, the hemp center may cut through on the drum. It takes about 30 wraps to fill the drum, and when the weight is put on the rope this causes the hemp rope to cut down between the other wraps. This condition varies both the amount of the cut back and the frequency.

When a steel center rope is used this cutting down between the wraps is eliminated.

By following a strict policy on cutting back and changing ends the life of the rope can be greatly extended. This is true for both preformed and non-preformed rope, and for hemp or wire center.

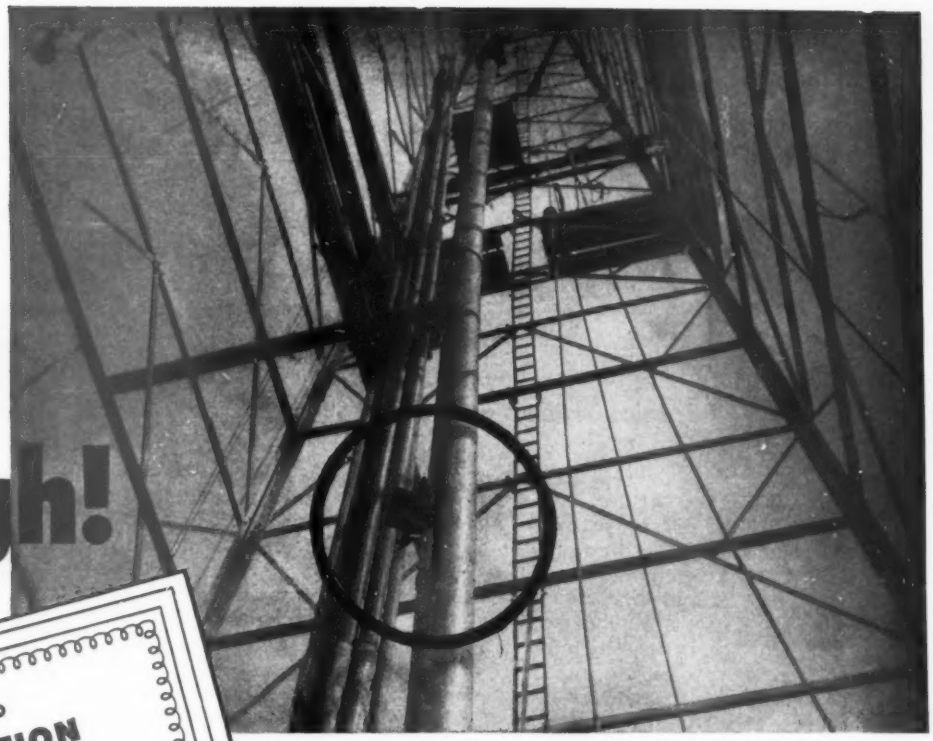
★ ★ ★

The drum on a diesel rotary outfit. In feeding a new line from the reel to the drum use of a metal plate is recommended so that the rope surface will not pickup sand and small gravel, which later will be ground into the rope, drum, and sheave grooves.



E. McDaniel examines a section of ¾-in. preformed wire rope with hemp center.

1 in 3 is not enough!



Surface Casing takes a severe pounding by drill pipe. When a lower joint fails, repair is costly, tricky and sometimes dangerous. 19 years of case histories prove that *every* Casing Protector *reduces* the force of this destructive pounding, *but* one Protector for every joint is needed for maximum prevention of casing trouble. *One Protector per thribble is not enough!*

Not long ago, only one Protector for every three joints was used while drilling a mid-continent wildcat. A bad hole was worn in a lower joint of the surface string. This happened because the 2nd and 3rd tool joints had no Protectors to act as bearings to center them in the hole and keep them from whipping into the casing. It was decided to try repair by cementing. While squeezing, two stands blew out of the hole and caused serious damage and injury. The Casing finally was pulled.

MORAL: If we could picture drill pipe turning in the hole, we would see that every joint without a Protector is a future trouble maker. We wouldn't wait for trouble to develop before rubbering 100%. Look up at drill pipe standing in the derrick and notice how much a 90′ stand bends when out of the hole. Then it will be easy to imagine how it whips inside the casing unless it is 100% rubbered. Protectors cost so little compared to damage, delays and repairs. Let your Patterson-Ballagh man give you 100% Protection today . . . get smoother drilling *all* the way!

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Chemical treatment of new and producing wells

By **NORMAN C. WELLS,** *Chief Engineer,* Chemical Division, Atlas Production Company

THE AUTHOR

Norman C. Wells, chief engineer, Atlas Production Inc., has had experience in the various phases of the oil industry for the past 21 years. He is a graduate of the University of California at Berkeley, class of 1925, and a member of Tau Beta Pi, honorary engineering society. He is an active member of the API and AIME and a charter member of CNGA.

EXCLUSIVE

WHEN a well has been drilled in, the mud chemist, like the drilling rig, is assumed to have discharged his immediate responsibility, and naturally moves with the drilling crew to the next location, leaving the completed well to the production department. Thereafter, from the moment it is placed on production until it is finally abandoned, every means is exercised to boost its economic yield to the maximum. Many methods, including chemical, mechanical, and hydraulic, are used to remove any impediment to migration of fluid from the formation into the hole. Each is normally successful if the basic cause is properly determined, environmental conditions are clearly diagnosed, and the chosen procedure, in the face of those facts, is a logical one.

It has been found that under many commonly encountered conditions, chemical treatment can be used with highly satisfactory results, bringing about substantial increases in production, and sustaining such increases over long intervals of time. The magnitude of these effects and their prolongation is due largely to the fact that chemical treatment, when properly designed, reaches out behind the liner, extending to the materials between it and the sand face, including the mud cake, and, thence, out into the formation itself. In a well that is already producing, it becomes obvious that all the materials in the areas defined may be considered as in the oil phase. It will be easier to understand the reactions that take place under chemical treatment, if we first acquire some knowledge of the nature of the materials with which the problem deals.

The accompanying diagram (Fig. 1) shows a cross-section of a typical well bore, including a liner or oil string. For the purpose of simplification, a conventional completion is illustrated, although the principles of chemical treatment apply in other cases, with the necessity, perhaps, of some minor variations. The areas of interest in chemical treatment are segregated and defined in the diagram already mentioned, and it might be specifically remarked that the critical areas are those designated as D and E.

Examining first the various materials that are ordinarily to be found in area D, between the pipe and the sand face, we find that they can be segregated into two general classes—harmless and harmful—that is, with respect to their effects on production. Each of these two groups may be subdivided into the respective classifications shown in the following table:

Harmless material	*Harmful material*
Coarse sand	Silt
Gravel	Clay
Broken up shale	Wax (asphaltines, paraffins, etc.)
Broken up cement	Mud cake
	Hydrated bentonitic shale
	Scale (calcareous material, etc.)
	Stray cement

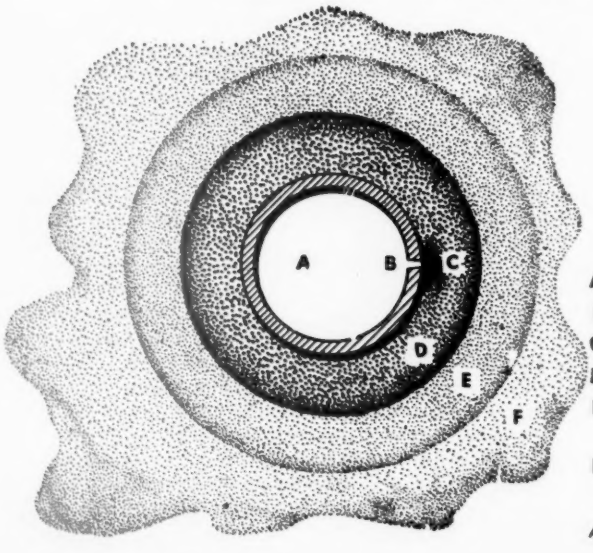
It must be remembered, of course, that the harmless materials often act as retainers of harmful materials, and to them, thus, are often erroneously attributed results for which they, alone, are not really responsible. For example, coarse sand packed with silt, clay, and mud, may be referred to as "a bad sand condition" between the liner and the formation. Actually, however, if the sand were cleaned of other materials, it probably would be even more permeable than necessary, and have beneficial hole retaining properties at the same time. Gravel, or gravel and sand, would be in the same category. In fact, part of the benefits of gravel packing may be lost by the retention of harmful materials, perhaps to a considerable depth.

All so-called "harmless" materials are only harmless under normal conditions. Coarse sand, desirable from many considerations, can under high velocity conditions cut out the liner and cause considerable trouble. Pieces of flat, broken shale, may rest against perforations and plug them off. So, any material must be assumed to be harmful under certain conditions. In this discussion, ideal conditions are postulated, and materials are classified as harmless when it is known that under ideal conditions they have beneficial hole retaining qualities. None of the materials designated as harmful, can have hole retaining qualities without at the same time adversely affecting flow.

Examination of harmful materials involves consideration of the area, designated as E on the cross-sectional diagram, and the following notes detail more intimately the character of these materials, and the manner in which they react to a rationally developed chemical treatment.

● **Silt.** In the category of silt we have very fine particles of sand or clay. Positive and negative charges on the surfaces of these particles cause them to have a loose but effective bond so that they group themselves and act in small

FIG. 1. Cross-section of typical well bore.



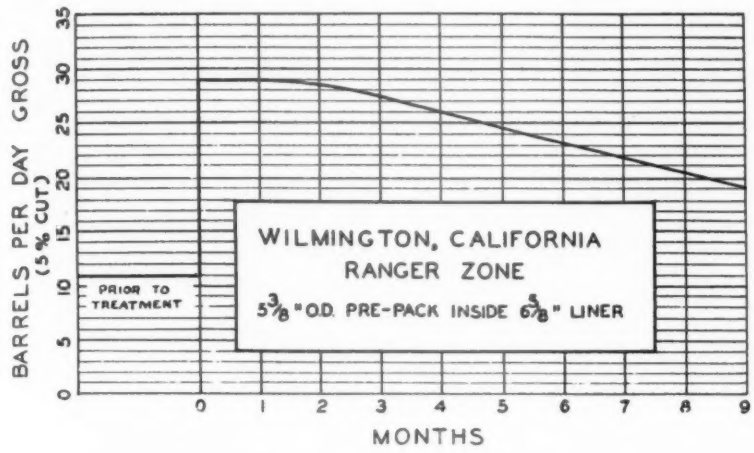


FIG. 2. Decline curve of a well in the Ranger zone at Wilmington, California.

masses instead of as individual particles. This condition exists in areas E and F as well as in area D. Intrusion of foreign fluid, particularly but not exclusively, fresh water, will result in a film of this fluid intruding between particles and forcing them apart due to the looseness of the bond between them. The bond is not broken, however, and the small masses become larger masses. Any foreign fluid might do this, even oil. These masses have a blocking effect and reduce the permeability of area D, and more particularly E. This is often referred to as a water block and in many instances the surface tension of intruded water receives the sole blame for it. The function of an adequate chemical treatment must be to rearrange these charges so that the bond is broken and the particles can act individually. They are so fine as individual particles that they will percolate out with the flow of production and probably remain in suspension in it.

● **Clay.** In one form clay has been considered in the same category as silt because of the similarity in performance. In another form now being considered, these particles have a binding material upon which the requisite chemical has a reaction that results in the release of gas. This release of gas helps to break up the mass and remove it. The clay particles then come under the category of silt and behave accordingly. In some cases water has a dissolving effect on the binder, but the swelling effect described above is usually many times more effective than the removal of the binding material. This can be understood when it is realized that swelling in the order of 12 times may occur. Some types of clays are worse than others in this respect. Clay used in drilling mud is usually of this type to some degree. It might be well to note that drilling fluids such as oil, when used in sedimentary sands, soon become loaded with clay and acquire some of the disadvantages of clay-based muds particularly when a little connate water is added. They do not, of course, have the disadvantage of comparatively high water loss. Mud cakes resulting from such fluids, however, are very amenable to specialized chemical treatment because of their high clay contents.

● **Wax.** Wax deposits with which we are concerned occur near the sand face, in area D, and in gravel packs. Many times this deposit occurs without the operator's knowledge, because it is not necessarily accompanied by large deposits in the tubing and lead lines. When present in large quantities, such as in gravel packs, it is broken down chemically and is then removed in the form of a material of the consistency of molasses.

● **Mud cake.** Most of the considerations of mud cake have been discussed with those of clay. It might be well to point out, however, that fresh mud cakes are quite different from those to be treated. Mud cakes in the hole are in an oil phase and have been subjected to elevated pressures and temperatures for some time. They also are amenable to treatment by carefully designed reagents.

● **Hydrated bentonitic shale.** The swelling of some shales upon contact with water is well known. The action and the result of chemical treatment is similar to that described in the discussion of clay.

● **Scale.** Most troublesome scales are deposited on the liner surfaces and originate from water. These scales require an ordinary acid treatment for their removal. In some cases enough mud or clay is included with the scale deposit so that a special chemical, in removing this material, will break up the scale or calcareous material. Mechanical means are usually resorted to in removing scale.

● **Stray cement.** Stray cement is best removed by mechanical means.

● **Well cleaning.** Having discussed the various types of materials to be encountered, let us turn to well cleaning with reference to the cross-section illustration of an oil well.

Mechanical and hydraulic means are available to clean out partially the material in area D. Some of them may in a few cases penetrate the wall of the hole, but when this occurs the part that is penetrated becomes part of area D. Most cleaning jobs soon lose at least some of their initial benefit by reason of the fact that area D tends to resume its original condition as it was before cleaning. Then the sand becomes plugged again with mud and silt from areas D and E at the critical point of sand bridging at C. The sand alone in area D is not to be blamed, for its permeability is much greater than that of the sand bridged perforations. The sand bridge,

One method of introducing the chemical at the wellhead.

the point of highest velocity in the system outside the bailable area, is assumed to be necessary to prevent the entry of sand in large quantities with consequent mechanical difficulties.

To obtain maximum results from cleaning, then, the permeabilities between area F, the virgin sand, and the sand bridge must be increasing with increase in velocity of fluid being produced. (The relationship is not a direct proportion). From this it can be assumed that the relationship of permeabilities must be greatest in order as follows: C-D-E-F, as nearly as possible. If the sand bridge is clean of mud and silt, conditions at C and F are fixed.

To condition areas D and E so that they will meet the requirements, it will be necessary to remove mud and silt from the sand. (Note that it will not be necessary to remove sand from D.) To do this, the mud and silt must be reduced to fine particles so that they will percolate through. This mud and clay has been hydrated so that it is difficult to break it down into fine particles. The chemical, of course, is designed to do this very thing, and permit the clay particles to be removed by washing action and with production. If the cleaning has extended sufficiently far to extend the area E out so that the velocity of the flow of production through F is so low that it will not transport silt, the cleaning job will be permanent. Any approach to this will be an improvement over just partially cleaning area D.

The total area of favorable oil sediments under water in the world is estimated to be between 50 and 55 million cubic miles, according to a prominent oil geologist.

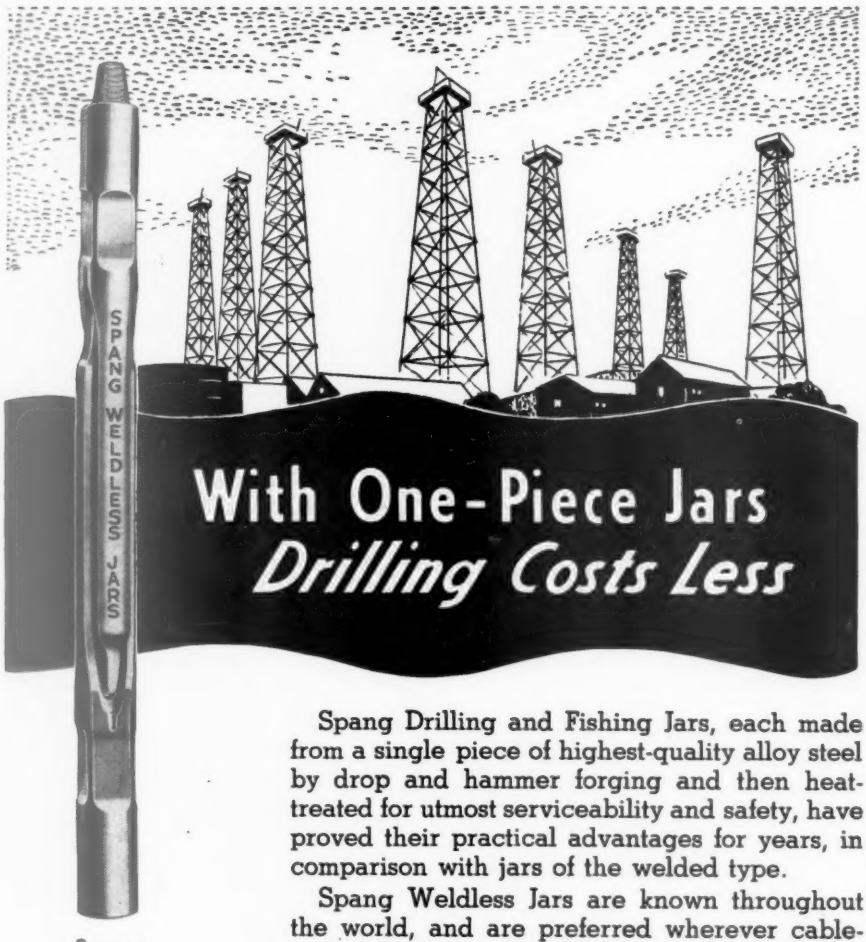
☆ ☆ ☆

In these considerations, the importance of using mechanical and hydraulic means of aiding in obtaining distribution of the chemical and in helping to move spent chemical is not to be underestimated. The economics of each and both together must be duly considered.

To illustrate the sustained increase in production accomplished by a carefully conducted chemical treatment, refer to the decline curve, Fig. 2. The actual decline curve is that of a well in the Ranger Zone at Wilmington, California. This was a pre-packed liner inside of a liner, representing maximum possibility for re-plugging. The sustained nature of the increase is quite striking, considering conditions known to exist in the field where many pre-packed liners are in service.

Any such chemical treatment of oil wells would indicate the advisability of using this type of treatment on new completions. This would once and for all clean up mud cake and rectify any possible condition of hydrated clay in the sand that might have resulted from water loss from the drilling fluid. It is not often that field experiences can place a finger on the exact value of this cleaning; however, it can safely be assumed that if it does the job it is worthwhile in the long run. One example of proof of the action of the chemical in completion work is rather interesting. The bottom of an old hole had been cleaned out using mud. The mud was circulated out with oil that stood for some time at the top of the hole without loss to the formation. The chemical was spotted and in less than an hour fluid went away rapidly indicating a break down of the mud cake. This was in an 8500-ft hole.

In conclusion, it should be stated that the chemicals capable of performing the functions here described are quite harmless to eyes, skin, or clothes, hence, do not in any way endanger the operator or his property. They can be delivered to the well in powder form and there mixed with either fresh or salt water. They mix readily, and have no deleterious effect on metals, cement, or rubber, thus do not corrode or impair pump parts, tubing, or other well accessories. Bottom-hole temperature exerts a beneficial influence on the reaction, and the treatment causes no damage whatever to the oil itself, or to the process units by which it is subsequently handled. Thus, the application is simple and fast and leaves the operator with no problems resulting from it. ★★★



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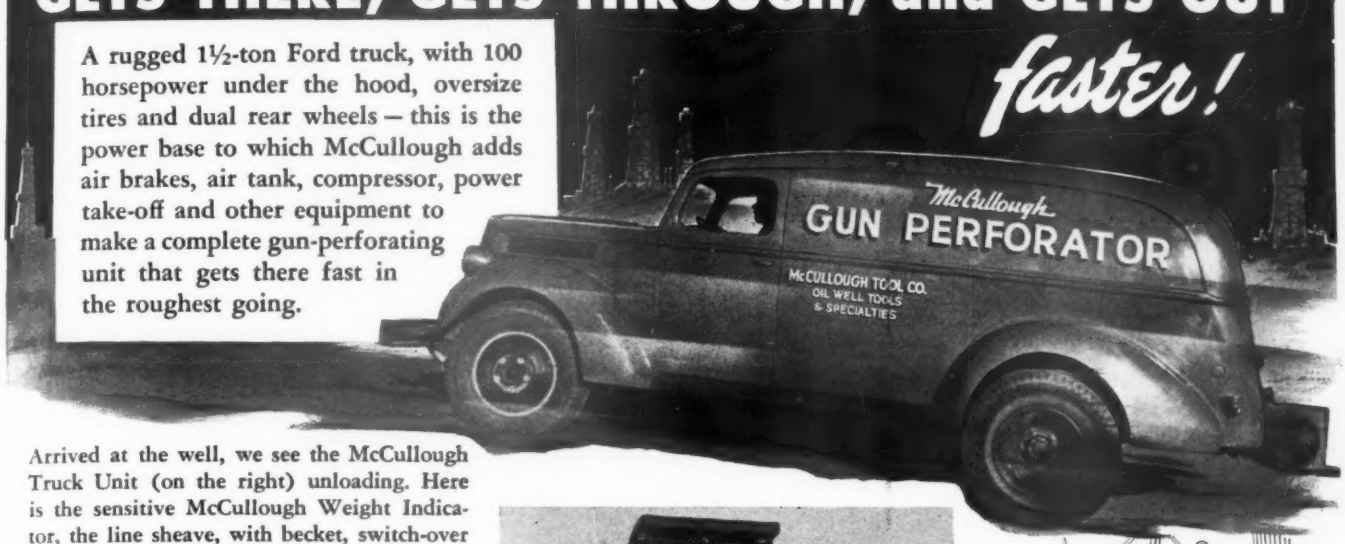
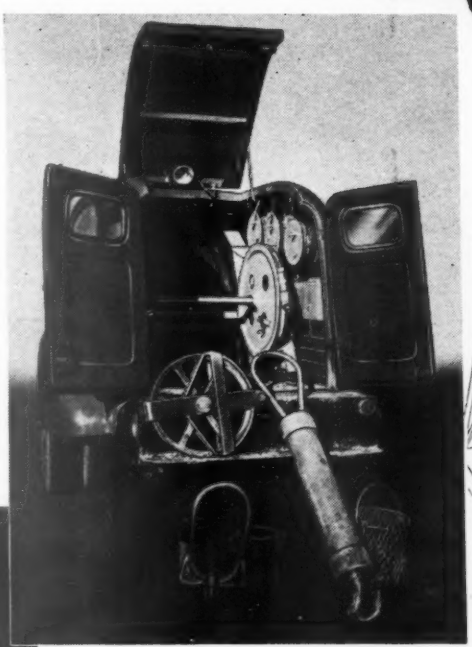
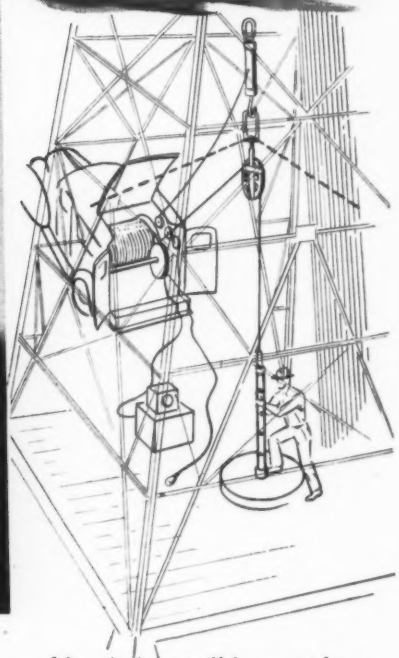


Arrived at the well, we see the McCullough Truck Unit (on the right) unloading. Here is the sensitive McCullough Weight Indicator, the line sheave, with becket, switch-over nipple and "Oil-Saver" packing head (a small blowout-preventer). In the truck, you see the line reel and measuring sheave, and the reels of cords for electrical connection to the rig. Overhead is a spotlight for night operation.





Below is the operator in the truck, his hand on the brake that controls the line travel, as he watches the shock-mounted instrument panel. This panel contains a two-way loud speaker, sonic indicator switch, line testing plug, multiple-stage weight indicator, line speed indicator, depthometer, line-testing switch, volt-ohmmeter, and combination shooting switches —the latter so arranged that the gun cannot be fired accidentally.

The sketch at the right shows the complete, quickly-made hookup as the gun starts down the well—electrical connections made to the weight indicator, the loud-speaker and shooting switch. All these connections have different type plugs, making it impossible to make a wrong hook-up. To render accidental shooting absolutely impossible, the gun cannot be fired unless the man on the rig holds down *his* shooting switch at the same time as the truck operator presses his *two* switches.

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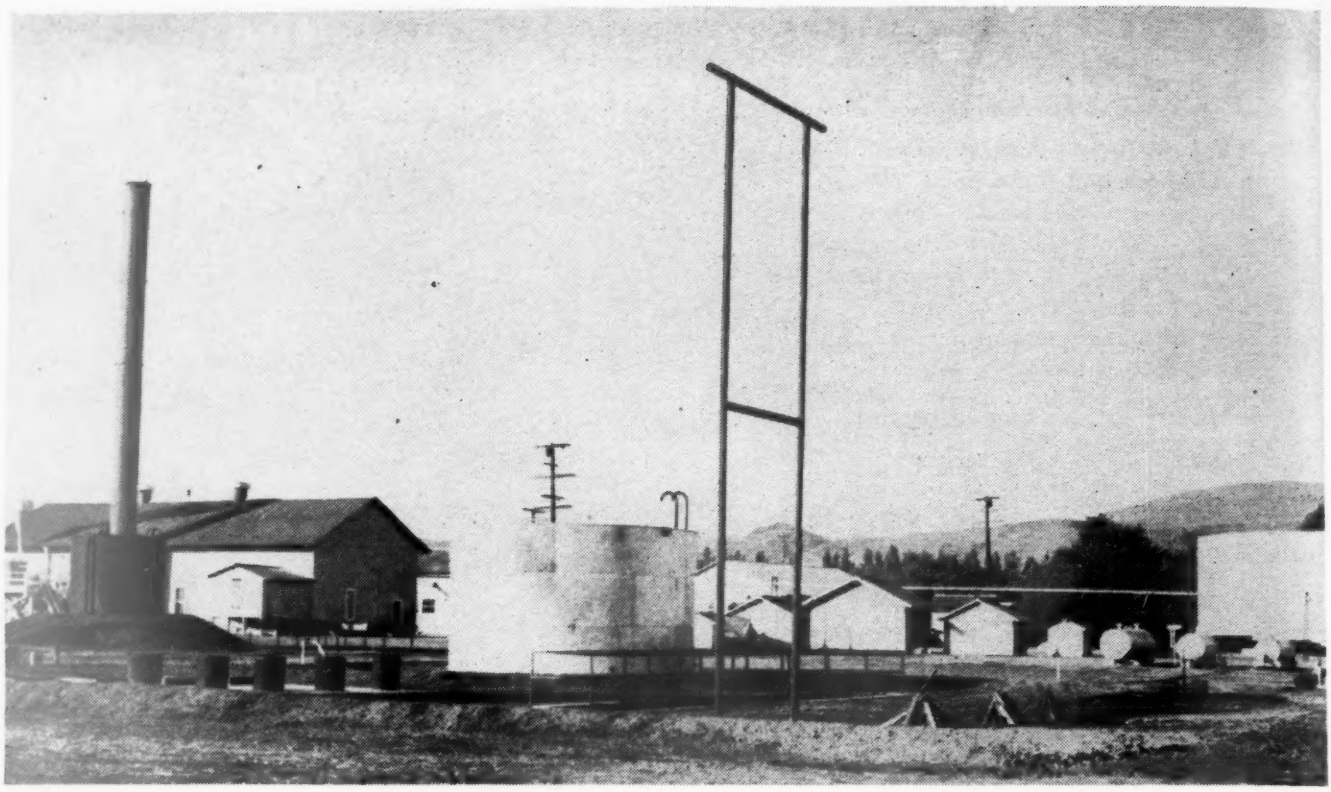

General view of Union Oil Company's "fire school".

Pipe line fire protection

By **RICHARD SNEDDON,** Pacific Coast Editor

EXCLUSIVE

THE institution of an adequate system of fire protection for petroleum pipe lines is neither a static nor a standard procedure. It is not static because we daily enlarge our knowledge of the character and behavior of petroleum hydrocarbons, and, simultaneously, must constantly adapt our fire-fighting and protection devices and supplies. It is not standard because there are different kinds of commodities stored or handled under different conditions on every line; no two stations have either the same facilities or the same environment, and there are wide variations in the numbers, and the training and experience, of local personnel.

All these factors are determinants of the hazards involved and the facilities that must be acquired in order to provide the maximum of fire protection. Just how completely every contingency must be taken into account, when a proper appraisal is made, may be gathered from the details of a fire protection survey, as outlined by J. Hill, supervisor, and C. H. Van Marter, assistant supervisor, of the safety and training department of Union Oil Company of California. The first step in the process of evaluation is a general examination, without attempt to go into too much detail, of each individual station, to ascertain the following facts:

(1) *Where is the nearest fire department—city or county—and what facilities does it have available to aid in case of a fire?*

The city or county fire department is an important consideration in the setting up of a fire protection plan. Find out of what its equipment consists. Can it be depended upon to answer all alarms? When out of service, does it have a covering arrangement that permits a secondary station to respond to the call and take over? Determine the actual time that will be required by both primary and secondary stations to reach the site when answering an alarm, and make the data a matter of easily accessible record.

(2) *What is the number and qualification of company workers available for action in case of an outbreak of fire?*

Quite often incipient fires can be extinguished in short order by company employes, if they are properly trained, and the right equipment is available. Choice of primary or secondary equipment will depend to a large extent on the approximate number of men available on each shift. It is expedient to know whether or not additional personnel over and above those on duty, and those who might be expected to respond from the fire department, are on call; and how long it will take them to reach the scene in case they should be required.

(3) *How many oil containers of what types are in the immediate area? What are their dimensions, and what commodities do they contain?*

The diameter and heights of the containers are more important on fire protection than their capacities, although pipe-line workers incline to relate measurement and capacity automatically. Accessibility of the containers to fire-fighting equipment should be gauged, and every effort made to move or replace any impediments that are not immovable or

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indispensable. As the character of the commodity determines the method by which it shall be protected, it is important that the nature of tank contents be known to the fire-fighting force, and that they be informed of any subsequent changes.

(4). *What water storage is available, and what facilities to permit its application effectively?*

All storage measurements should be given in gallons, and pumping rates should be in terms of gallons per minute. Line sizes, and approximate distances from supply to pumps should be recorded. Residual pressure, that is fire department pumps and/or company pumps suction pressure at full operating capacity, should be directly determined, or the data developed by which this value may be calculated.

(5). *What are water line sizes?*

Discharge line diameters and lengths should be recorded. Data should be compiled, or sketches made to show the nature of water lines; i.e. whether single, double, looped, or looped and gridded, etc. Similarly, all valves or other devices used for the purpose of isolating specific areas.

(6). *What are the capacities of fire water pumps?*

This is obviously essential information, and should be accurate. Calculated capacities are not sufficient—they should be determined by actual flow tests.

(7). *What types and sizes of fire hydrant are available?*

Thread standard of all hydrants should be a matter of record, and they should be examined with respect to the ratio of hydrant outlet diameter to the diameter of the riser. It is apparent, for example, that the outlet is not necessarily an indication of the volume of water that can be pumped, for in a poorly engineered installation a 2-in. riser may carry a 2½-in. outlet. On the other hand where water pressures are lighter than normal (e.g. 300 psi) this may not adversely affect the efficiency of the system.

Tank, 12 ft high by 20 ft diameter, is used for training in extinguishment with fog applicators or foam generators. Subsequent training involves larger towers.

(8). *What types and sizes of fire hose are available?*

It is hardly necessary to say that the condition of all hoses should be determined. They should be examined carefully to see that threads conform to the standards adopted, and that sizes, types, and conditions are specified.

(9). *What types of fire nozzle are available?*

A description of the types and models of hose nozzles is of the utmost importance. Note whether they are straight stream, fog, or combination, because this will definitely affect the ultimate fire protection plan. If fog or combination nozzles are available, the make, size, and model suitable for one particular purpose, may not only be unsuited but actually dangerous in another fire fighting problem.

(10). *What foam facilities are available?*

Obtain a record of the types, sizes,

First instructors' class enrolled at Union Oil Company's northern division fire school. It includes county firemen, Bureau of Mines personnel, and supervisory employees from the company's production and pipe line departments.

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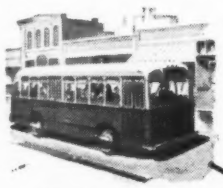

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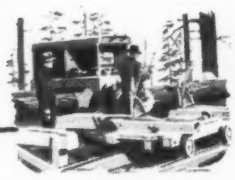
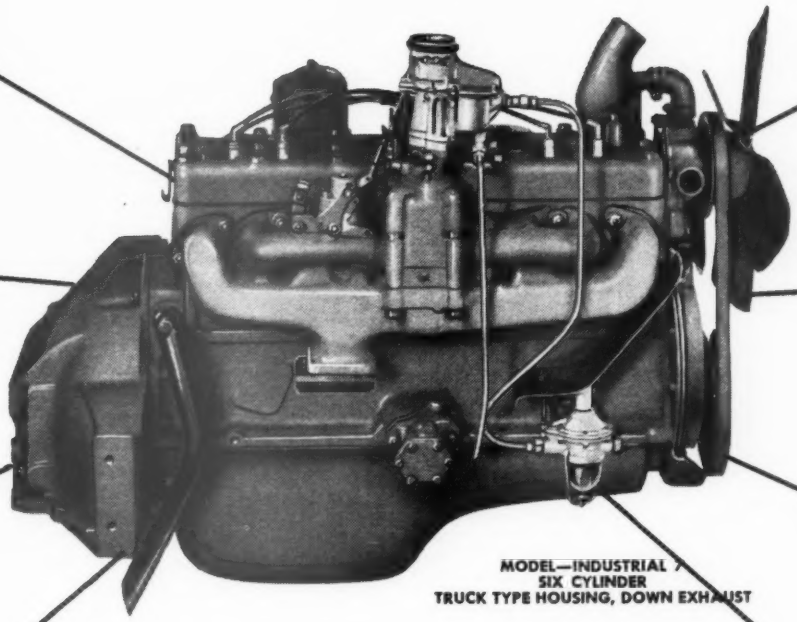
Portable Crane

Water Pump



Lumber Saw



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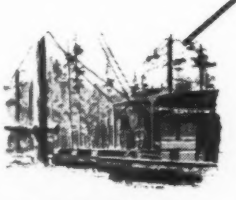

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and model numbers of foam generators, both portable and static, and foam chemicals. Only from such data may one calculate flow and foam generating capacity, and the general adequacy of the equipment in relation to the hazards involved.

The degree of portability should be specified, e.g. are the generators mounted on carts as manually portable units; on trailers carrying all portable equipment; is other material just lying in warehouses, or is it mounted in some way and capable of quick transport to a chosen locale. The nature and capacity of supplementary foam equipment, such as foam towers, hoses, etc., should be of record, and whether or not hoses are restricted to foam use, or may also be used for water, is important in the evaluation of stocks.

(11). *What maps are available?*

Accurate up-to-date maps, showing locations of buildings, structures, oil lines, water lines, valves, hydrants, etc., are essential to any fire protection program, and they should be the subject of constant study by the operating personnel, until they are as nearly as possible memorized. Meantime, however, the maps should be posted in prominent places so that they may be referred to frequently.

(12). *What is the likelihood of coordinate protection, other than that offered by local fire departments?*

Consultation should be held with related departments, such as drilling and production to determine to what extent and in what manner their fire protection facilities and crews may be merged in the common cause. It would obviously be foolish to duplicate facilities in two overlapping or very closely adjacent departments, or even to institute separate and distinct training programs, when the modus of protection is the same in either case, and both being parts of the same entity, a fire loss to one is a fire loss to both. There is no question, in addition, that joint operation in this important respect would result in better all around fire protection at appreciably lower cost.

With all the foregoing information established, the analyst is now in a position to get down to specific preparations and recommendations, some of the more obvious of which are here defined. It must again be emphasized, however, that a program of fire protection is not by any means a static or standard process, universally applicable and infallibly effective. Every organization, and every area has its own specific problems, and it is the function of the fire protection engineer to adapt the fundamental principles, and apply his own rationalization, to cope with any series of hazards, regardless of their nature. It is true, nonetheless, that in many particulars any program can be standardized, and can be premeditated. The following are steps that experience has already indicated to be essential. They can be construed early in the proceedings, and so help to expedite the entire program:

(a). In every case where tank fires constitute a hazard, two pumper suction connections should be installed. In some instances, plant lines downstream from the suction connections may be suitable for use as transport lines, thus reducing the hose requirement, and coincidentally, keeping the hose farther removed from any tank fire that may occur. When multiple suction connections are installed in this manner, check valves should also be inserted, and the number and size of pumper discharge connections will be determined by the size of the main suction line.

(b). It is a matter of simple mathematical calculation to decide the quantity of water required for cooling. This should be done for all tanks, and an adequate supply of water assured.

(c). In some sections, the nature of the terrain, and general considerations, may lead to the conclusion that isolation of fires is more economical and even more desirable than the installation of facilities to fight them. This should be borne in mind when the definition of a fire protection system is in progress.

(d). It is important to draft a manual of instruction, preferably containing a preamble dealing with fire fundamentals, various types of fires, methods of control and protection. It should also include a general discussion of related hydraulics, the application of foam firefighting practices, and an outline of the specific program and data that refer to the district in which the receiver of the manual is to operate. A limited quantity of technical data, suitable for reference, and for exposition during the training period, could be added in the form of an appendix, and it would be well to see that such material is in conformity with recently approved standards.

(e). Cognizance must be taken of recent technological developments, in commodity, equipment, or technique, particularly as these appear to affect the prevailing fire protection procedures.

(f). All connections, hose, hydrants, nozzles, valves, etc., must be standardized, so that so far as possible equipment from neighboring stations is usable and interchangeable.

It is believed by these investigators that for the handling of Class A hazards on the pipe line, the most effective instrument is the 5-gal pump tank soda-acid extinguishers. For Class B fires, dry chemical extinguishers are recommended.

Smaller devices such as 2-lb carbon dioxide, and 1-qt extinguishers, find little use on the pipe line, although occasionally a small solvent fire in the gaug-

Two firemen begin the attack on a pipe trench fire. Nozzle man backs up the instructor first time in, and on the next approach actually takes over, with a new man to back him up. This system is continued so that everybody on the crew eventually has a shot at the front position, closest to the fire.

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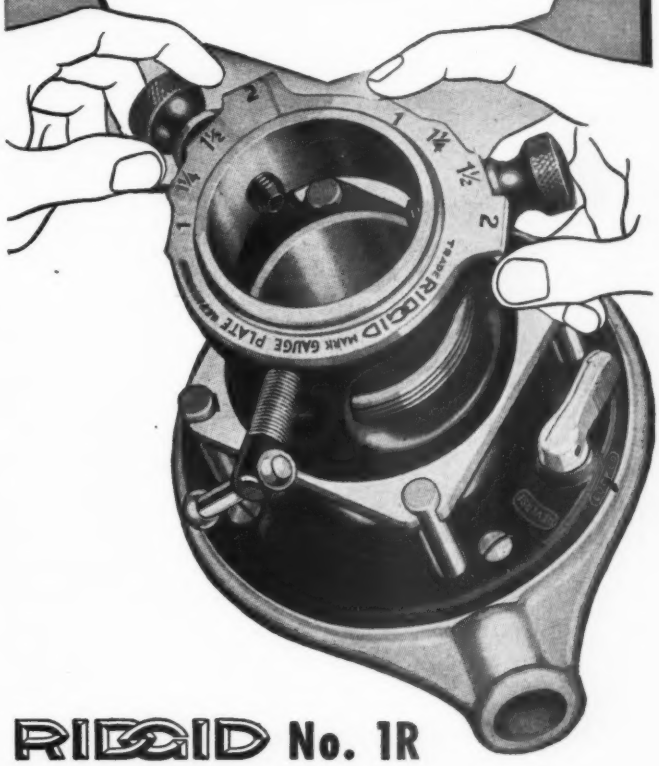

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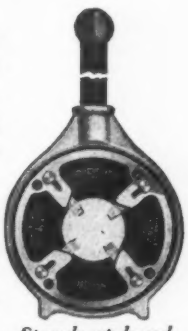

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Pipe line and production department supervisors are demonstrating their ability to handle a hot fire. This is a simulated christmas tree, discharging several streams of casinghead gasoline at high pressure.

er's laboratory may be subdued with the small CO_2 unit. Units of 15-lb capacity or larger are sometimes of advantage in pumphouses that do not have a free circulation of air. In outlying areas, however, it is necessary, when the CO_2 units have been exhausted, to send them away for replenishing. This may take four or five days, and, thus, it is best to confine their use to central, more or less metropolitan locations, where reloading is not such a time-consuming operation.

Needless to say, it is important that a detailed check of all fire-fighting facilities, and all pertinent equipment, at each pump station, is vitally necessary to an orderly protection system. Suitable connections must be available for city, county, or Forestry Department equipment—two at each location. These often send two pumpers to each fire, one with cooling water and one with water for foam application.

Where water is purchased, it is essential that meters of small capacity be bypassed for emergency occasions, or that larger meters be installed. In either case the change can only be made by arrangement and agreement of the water company, and it is too late to consider the idea after the fire has started, so it had better be done *now*.

It is advisable to check all towers and make sure they are light enough to be easily handled by the number of workers available, yet heavy enough to stand the rigorous treatment to which they are subjected under operating conditions: Extension towers of aluminum alloy may fill the bill where extreme conditions are likely to be encountered. In this connection, strategic locations should be selected for the general storage of towers, foam powder, corrugated iron sheets, hairpins, etc., and the quantities stored should not be decided with a ouija board. They should be calculated carefully in the light of the hazards involved, and with a sufficient margin to make sure that under the most severe conditions that *might* prevail, there will be no danger of a shortage.

Besides having an adequate store of the right equipment and supply, in the best selected quarters, there must, of course, be an adequate array at any individual station that is too remotely situated to be protected by coordinate action. Corrugated iron and hair pins, for example, must be ready in the proper place and in the right quantity to provide flare backs around the largest containers. By the same token enough foam powder, and the facilities for its admixture with water and final introduction must also be available for prompt use. In addition to providing the mechanical and commodity essentials, a carefully organized plan must be developed for each station describing the types of fires to which the station is subject, and the appropriate method by which each may be controlled or subdued. This with all the pertinent information that can be developed should be a part of the manual that has already been discussed.

In general, there are two types of fire with which the pipeliner is likely to be faced: (1) Station or boiler house fire that normally could be handled by the men on duty, and (2) a tank fire that might require men and equipment in addition to those normally on duty in the area, and perhaps the help also of outside fire departments, as already suggested. Before discusing the actual methods of combatting or controlling these fires, it might be mentioned that to a quite noticeable extent fire-fighting techniques were advanced by war experience, and many former practices have been abandoned in consequence.

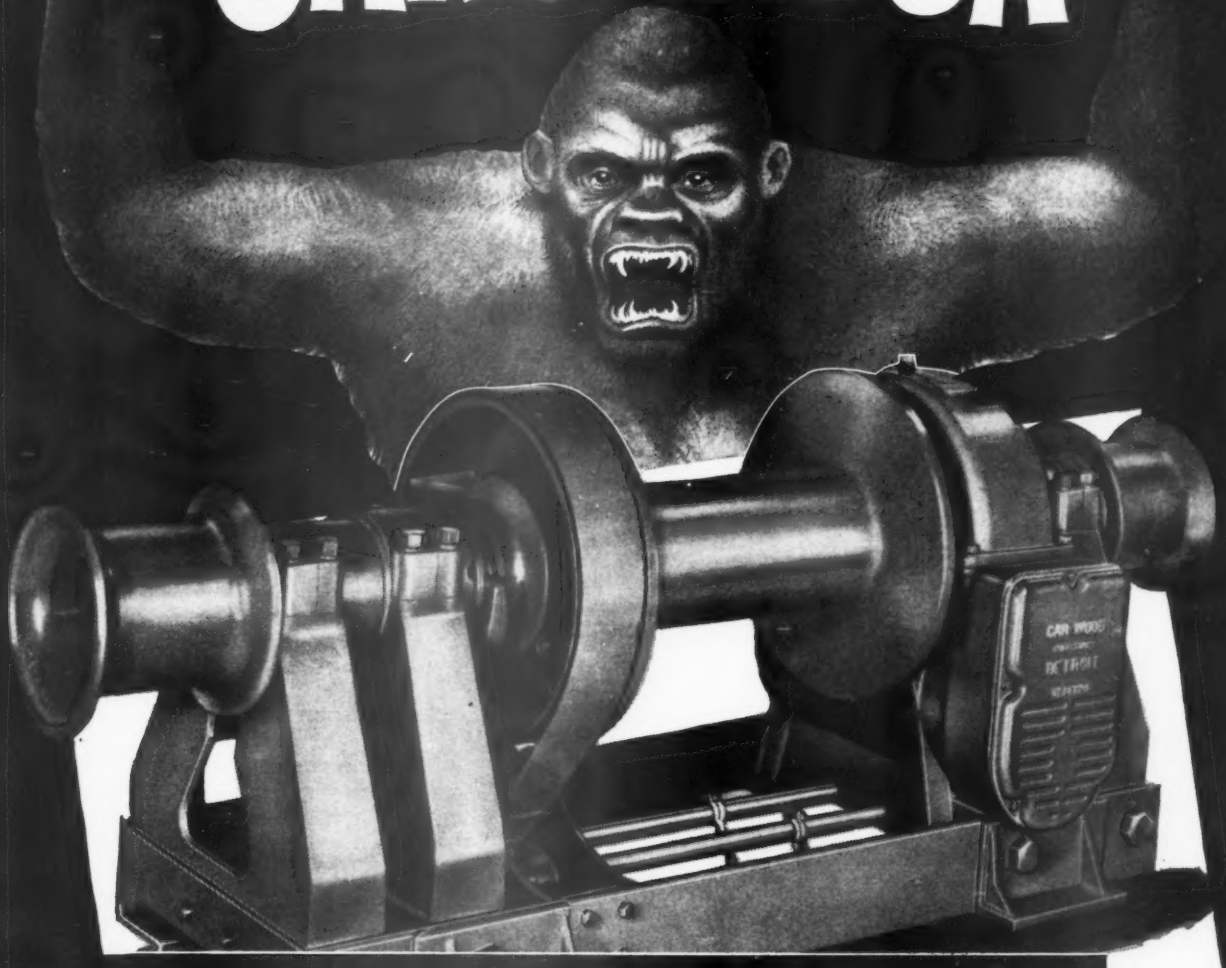
● **Station or boiler house fire.** The recommendation here is based on the effective use of water in 1-in. fog streams, in conjunction with dry chemical extinguishers. These mediums have proved effective for primary fire protection and are particularly adapted to pipe-line operation where often only one man is on duty and may be required to fight such a fire without aid. The equipment necessary at any station consists of one or two revolving cabinets, each containing 100 ft of 1-in. rubber hose with 1-in. fog nozzle attached. This cabinet revolves in a full circle and gives protection for a circular area 200 ft in diam. The water supply may be provided by a feed water pump, and in most stations it is possible to keep the line to the pump under pressure so that an immediate supply is available in case of fire. The actual water requirement of the 1-in. fog nozzle is 28 gpm, or 40 bbl per hr. The fog stream can be used effectively on any kind of a fire and gives fire protection to the operator. It is supplemented with the use of dry chemical extinguishers, the number required being determined by the nature of the facilities, and the presence of such devices, for example, as loading racks.

● **Tank fire.** The control of tank fires is a much more pretentious business that requires, as already indicated, a diversity of conveniently placed facilities, a well organized fire-fighting crew, and a full understanding of the involved principles and techniques.

It is fortunate that, except in the case of wooden roofed tanks, the likelihood of a tank fire is distinctly remote. In fact, a properly constructed API tank, with a minimum sheet thickness of 3/16 in. is almost impervious to lightning.

It is interesting in this connection that an API study of tank fires, covering the period from 1915 to 1925, and including many types of tanks—code and non-code—indicated that tank fire expectancy in the petroleum industry is something like one fire per tank every 5820 years. Despite this, however, the ultimate sufficiency of the protection system depends not only on its capacity to handle the more common kinds of outbreak, but on the facility and adequacy with which it can control any conflagration, regardless of size or char-

GARGANTUA



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acter. Thus, tank fire control remains an important essential of an effective pipe-line fire protection system.

Looking at the overall picture, the requirements are substantially as follows:

1. A sufficient supply of water, enough hose and enough fog nozzles should be available to provide a cooling stream for any tank that might catch fire.

2. A sufficient number of depots, strategically situated on the pipe line, should be designated for the storage of foam powder, generators, portable towers, etc.

3. Each station should have available at the nearest depot enough foam powder to fight fire in the largest tank at the station. (A 55,000-ft tank, approximately 115½ ft in diam, requires roughly 35,000 lb of powder).

4. The crews should be trained, not alone in the theory of fire fighting with foam, but in the actual practice.

5. Both night and day crews should be organized and practiced by periodical drills, so that there is no confusion when a real fire occurs.

6. On the basis of the information already cited, and the plan outlined in the manual, each station is in a position to tackle the control of tank fires in an orderly and intelligent manner. (The various types of tank fires and the methods by which they are held in check have already been defined in *The Petroleum Engineer*, April, 1946, p. 978.)

Union Oil Company's fire protection training program is designed to familiarize *all* involved personnel with control equipment and techniques. To accomplish this, each pipe-line division has one or more conveniently located "fire schools" where everything from small outbreaks to full scale trench and tank fires, are fought in actuality, and by all operators without regard to title or position. During the course of training, in which different types of fires are controlled and every type of equipment used on the pipe line comes into play, the operators are gradually moved farther along the hose and closer to the fire, until every man has had his turn at being up front. By this process, fear of fire, one of the greatest obstacles to adequate control, is dissipated. Once a man knows the fundamentals of fire, and has faced a major blaze with the proper piece of fire-fighting equipment for protection, he no longer *fears* fire. He still has a wholesome *respect* for it, but the fear is gone. That is one of the major objectives of the training program—to impress the trainee with the knowledge that understanding and proper facilities are the most effective combination when it comes to fighting fire.

An important feature of the training course is that key men at each station are given an intensive four-day session of instruction and practice, which not only fits them to cope intelligently with any fire situation that may develop, but also equips them to carry on the teaching and training of others, after the fire protection engineer has gone. With this basic training, a carefully written and comprehensive manual, periodic discussion and practice of the techniques, and occasional bulletins to bring information up-to-date, the fire protection organization is always alive and alert. It isn't something that has to be reassembled and revivified every time a fire occurs.

It might be noted, in conclusion, that aside from the choice of equipment and reagent, good housekeeping is a fire protective measure. The absence of oil rags or scraps inside the station, and weeds or oil pools outside, tend to accentuate the safety-consciousness of the workers, and a basic necessity to the building of a good record is the desire to do so. Good housekeeping, besides directly eliminating hazards, stimulates that desire, and is, therefore, itself to be desired. Also, it is a matter of no small importance to the success of any fire protection program that all departmental barriers be torn down, if there are any, and that fire-fighting personnel and equipment be applied unstintingly in the common effort. Indeed, such a humanitarian and altogether worthy objective, calls even for the elimination of company barriers, and, certainly, on no other ground are the oil companies so closely in accord as in their desire to protect their people and their properties from the ravages of fire.

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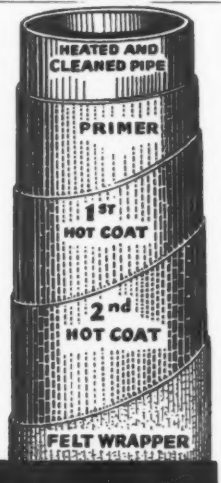

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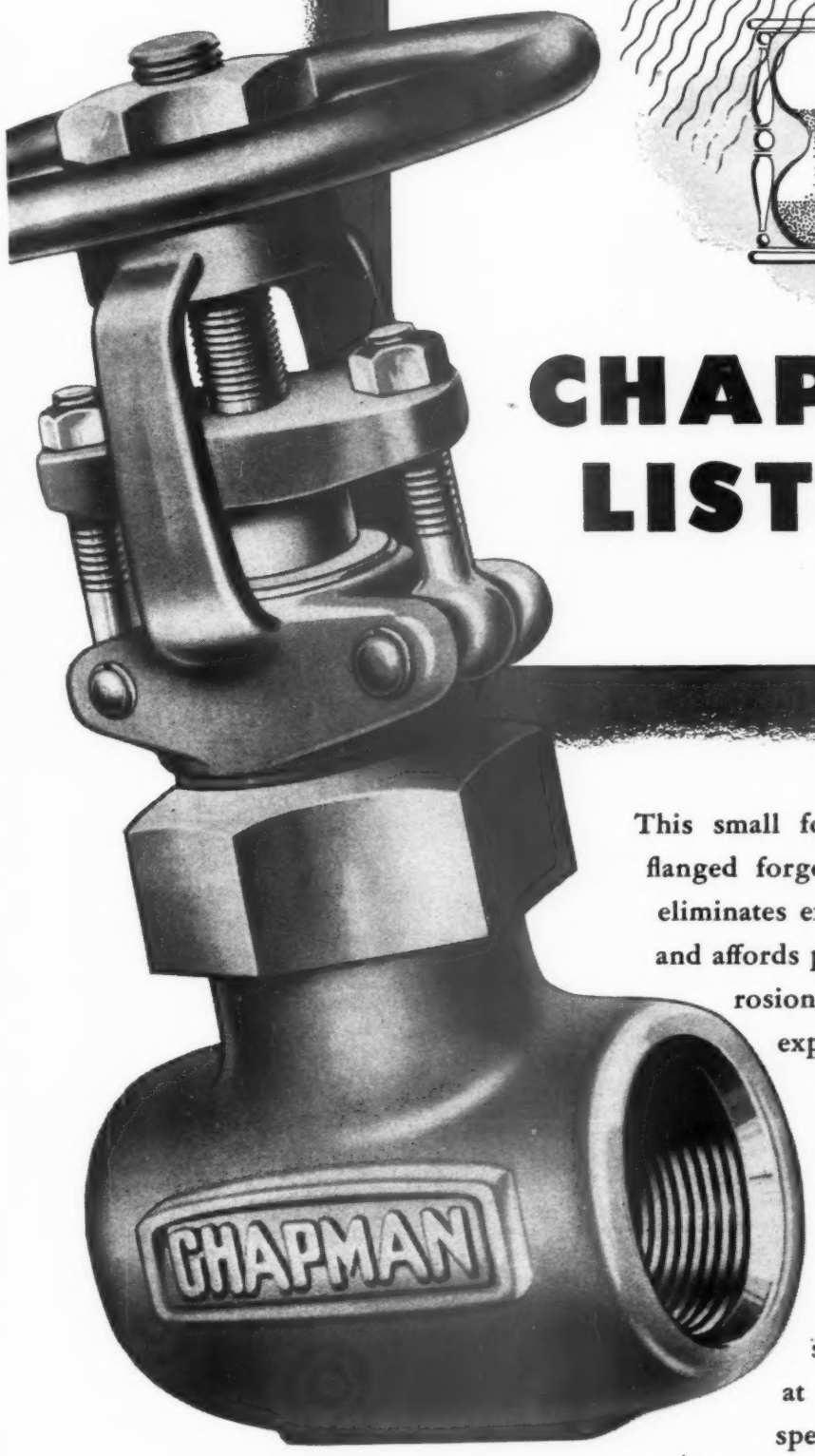

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Landowner is mutual partner in oil recovery

By **F. R. COZZENS**
Equity Oil and Gas Company

Oil recovery by mutual groups, especially as it applies to the relationship between landowners and producers, has proved quite successful with newly organized groups in the Eastern stripper fields. Combined efforts have enabled many modern recovery practices to be put into effect, as described by the writer.

EXCLUSIVE

CONSIDERABLE progress in oil recovery is now being made through cooperative action, whereby a group of producers combine their efforts and resources to develop a number of small properties as a unit. Several such groups are already in existence. Others are forming, and although many properties are too widely scattered for unit operation, there is a growing tendency in this direction so that individual operators may benefit and still retain their status as independent producers.

The cooperative road, however, is not strewn with roses. The group of independents who launch a mutual oil recovery program face more of a problem than is generally realized. Major difficulties do not always originate within the group, and some of its most perplexing problems cannot be solved by the members alone. While a project is still in the formative stage its sponsors will learn through experience (sometimes costly) that a field of corn or an acre of grazing land has as much bearing upon success or failure as does the site or operation of a producing well. This knowledge brings into the picture the status of a seldom-discussed partner, who, having little or no control over the wells has a very definite control over lands upon which wells are situated.

An individual producer seldom has sufficient prestige to make or break an organized group. One property owner can, however, by making certain concessions, assure the establishment of a project and render assistance beyond reach of the average producer. He can, on the other hand, by adhering to outmoded lease clauses, restrict benefits to fellow landowners, and through certain technicalities of the law he can "hamstring" a project. Such authority is sometimes wielded through sheer stubbornness. Sometimes the oil producer is to blame. The problem facing the producers is not in curtailing the landowners' rights, but in directing those rights toward the mutual objective of recovering oil. This can be, and is being, done by adopting a liberal give and take policy and by placing that policy in action while the project is still in the embryonic stage.

The initial forming of a mutual oil recovery group concerns only the producers. Probable value of the wells is estimated and decisions made on the type of recovery to be used, along with methods of its application. Details are unimportant in this first rough draft. Then follows discussions relative to pooling of equipment, expenditures, the role each separate property is to play, etc., all of which is put into a rough, general outline. This outline is then presented to the property owners, preferably at an open meeting attended by all persons concerned. At the very first meeting it is likely to be discovered that a site chosen for a plant, tank, or other item of equipment will interfere seriously with someone's cropping schedule, or a proposed right-of-way conflicts with the terms of a land deed. Changes acceptable to all are made on the spot through round-table discussion, and various other difficulties are ironed out before any expenditures are involved.

As the initial outline is flexible, changes usually can be made without inconvenience. The ultimate objective, however, must be kept in mind, and no substitutions made that would add materially to the cost or burden of the contemplated project. An oil recovery program is expensive, and the idea from the start should be to eliminate unnecessary costs in every way possible. Petty differences or grievances are brought into the open by round-table discussion, and although such matters may seem only of private concern, they can have a very detrimental influence upon a group that is striving to work together. An earnest effort must be made to settle as many of these difficulties as possible by popular vote.

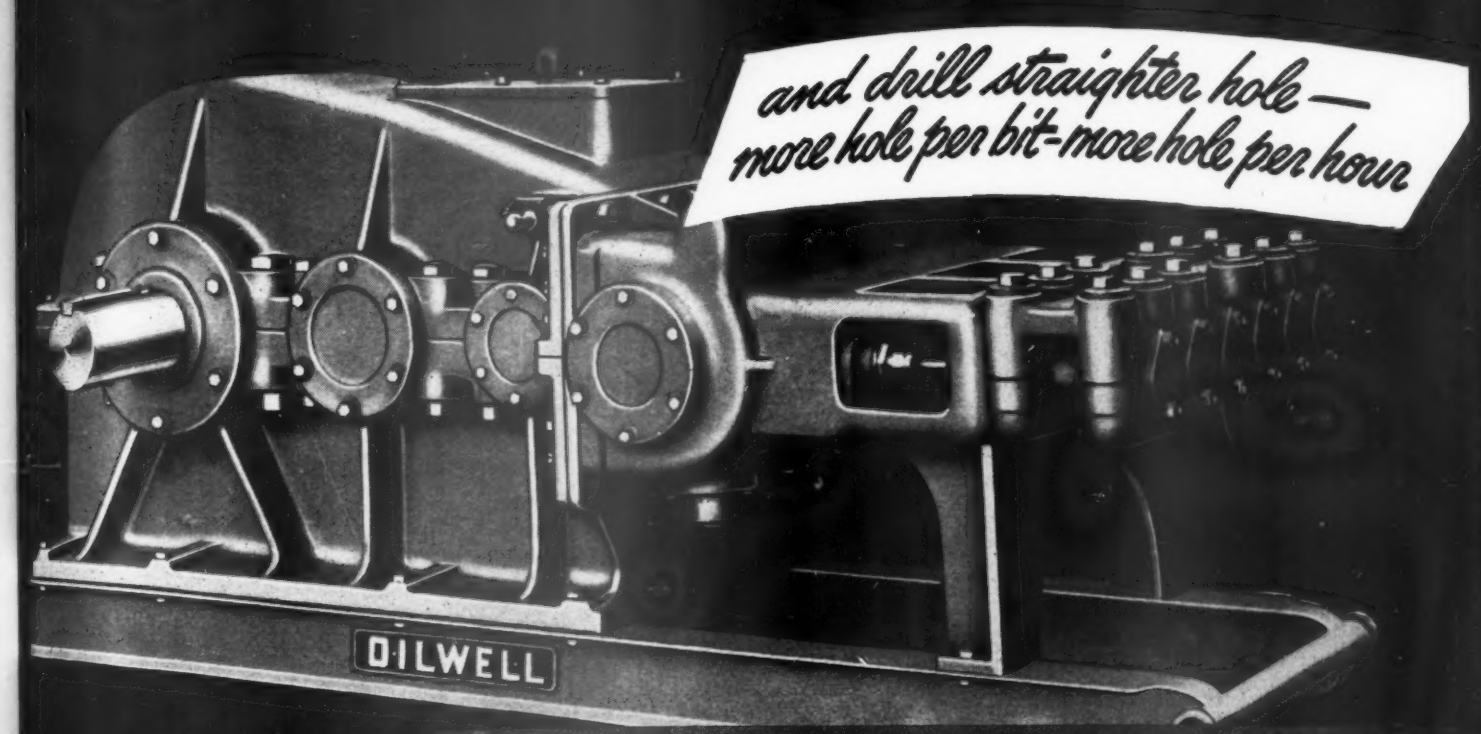
The follow-up step to the first meeting is an examination of individual leases to make certain that no obsolete, or partly forgotten, clauses interfere with the agreements reached. Many leases are handed down from owner to owner, and certain clauses likely will be found vague and difficult to apply to modern practice. Some producers supplement such leases with a working contract before an oil recovery program is begun. Others have leases re-written and brought up to date. All such documents should be in writing and lawfully executed because lands can change ownership overnight, and the purchaser may not be receptive to verbal commitments made by his predecessor. Another vital point is to make certain all boundary lines, especially those around marginal lands, are clearly defined.

Several meetings are usually necessary before all primary matters are agreed upon, but they provide the best known medium for reaching full agreement. Meetings preferably, should be held in the daytime so that disputed sites, etc., can be visited.

Although the producers who sponsor the meetings are generally expected to determine the method of recovery, this does not mean that property owners should be excluded from fundamental knowledge of its application. There should be stated reasons for the preference for a certain method, and why it is likely to prove adaptable to that particular project. The matter of boundary wells should be brought up and discussed; so should the disposal of salt water and other residue that result from the project. If line fences must be cut for the extension of rights-of-way across and between properties, suitable provisions should be made for the installing and upkeep of gates. Mutual interests are strengthened also by the assurance that each producer shares the opinion of the group, and is solidly behind the oil recovery plan. If sand analyses have been made (and they should be) many individual opinions will be clarified through comparison of sand samples taken from the separate farms. The average property owner may be rather vague in his knowledge of sand porosity, permeability, etc., but he likes to feel that he is being accepted into confidence. He feels freer to express his own opinions, which often serve as a balance-wheel in keeping the recovery program stabilized and workable.

Landowners, especially the older ones, can provide an abundance of oil field history, much of which is not always passed along when leases change ownership. They generally know the story and location of every dry hole in the district, along with causes and reasons for the abandonment of various old wells. They are familiar with experimental work that may have been tried out on their own, or a neighbor's wells. Some of them are in possession of valuable drilling records or well logs. Those who earn their livelihood from the soil also become somewhat of an authority on surface geology. A suggestion along that line may often prevent the costly mistake of bedding a compressor or other heavy equipment in quicksand or rubble-rock, or the setting of tanks against hill bases that are constantly slipping. Authoritative advice on surface drainage also can be given.

To the uninitiated, such miscellaneous information may seem inconsistent with the job of recovering oil, but ask the man who has seen service on a recovery job whether he was ever handicapped by too much knowledge, and the answer



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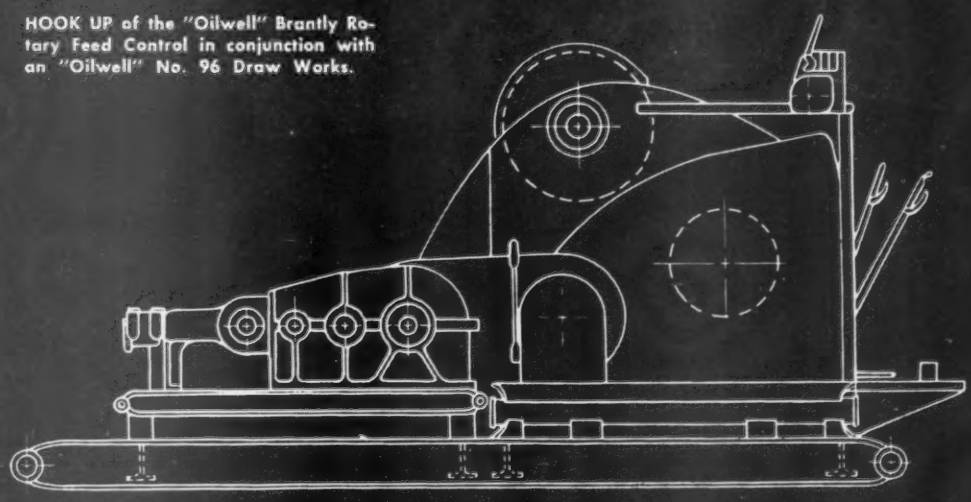

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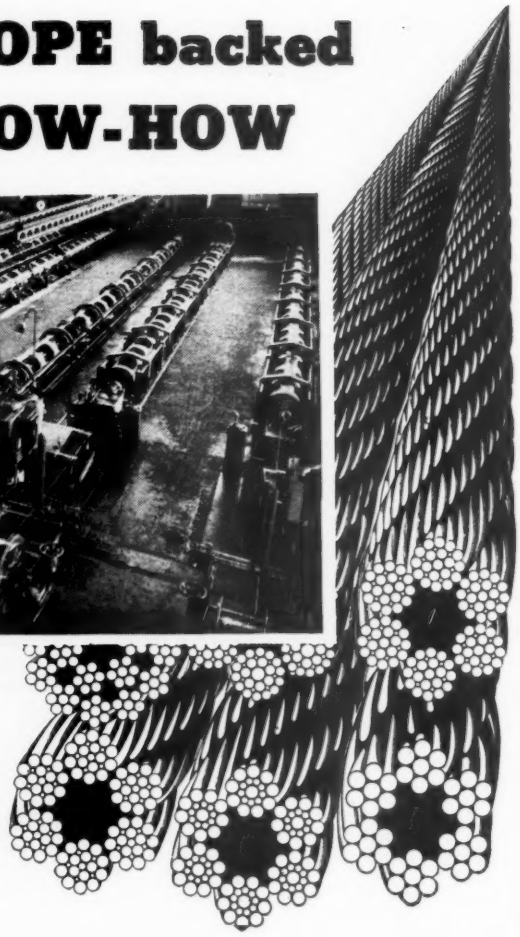

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is invariably "No." Secondary oil recovery, admittedly, is planned for the future, but future results depend to great extent upon what has happened on the project in the past.

Landowner cooperation, so necessary in bringing a mutual project into existence, becomes even more vital during those early days when no benefits are being derived, and transfusions of money and materials must be given repeatedly to keep it going. The landowner may not throw in ready cash (although some of them do) but he is in position to make other contributions equally vital. On many farms there is timber, suitable for derrick or line poles, or which can be sawn by local mills into lumber of various kinds. Refuse wood provides fuel for heating boilers or tanks. The owner can provide horses, tractor, truck, and sometimes portable pumping units for emergency jobs; also miscellaneous small tools. There is usually a farm workshop in which urgent repairs can be made. The modern farmer is qualified to assist in construction work, help out on a drilling rig or casing crew, or he can take a turn with the pumper. Often, he can provide storage space or out-buildings for the housing of machinery. He can aid in bringing electric service to the project through his community power lines. Using his influence with rural trustees, he can direct common funds to the improvement of roads connected with leases.

Oil producers should never feel adverse to accepting these various services, for the ultimate objective is to boost oil royalty interests as well as the operator's income. The producers, in turn, will see to it that the farmer's water supply is kept as free as possible from pollution by salt water and residue. Field crews will be instructed to minimize damage to crops, and to adhere to minor commitments, such as closing gates, etc.

After a recovery project has survived the crucial field-testing stage, its sponsors are much more definitely on their own, but there is continuous reason to be grateful for landowner cooperation. Having by this time a reasonable working knowledge of the operation, the landowner will not be suspicious when a neighbor's well shows benefits sooner than his own, nor will he object when pressure, or key wells are changed and certain wells closed in. It often happens that certain properties fail to yield the quantity of oil expected, whereas other farms produce more. Familiarity with the job goes a long way in helping alleviate these disappointments. The project operates more smoothly and at less expense.

Regardless of the oil-recovery method adopted, and the attendant circumstances, some form of producer-landowner partnership can be worked out, provided the effort is initiated before viewpoints and opinions have become set. Where a partnership can exist, there can be unity. No project has ever failed because of too much unity, and the project that has succeeded without it is yet to be placed on the record. ★★★

Shielding principle provides electronic micrometer

THE principle that the field surrounding a coil fed with alternating current will induce current in an adjacent coil and that the amount of current thus induced can be controlled by placing a shield or a low-resistance conductive medium at various distances from the latter coil is employed to make a linear reading device for use as an electronic micrometer. The shield is placed not between the primary and secondary coils, but adjacent to the latter. Its distance from the secondary coil determines the amount of energy produced in this coil.

The new device, developed by M. L. Greenough of the National Bureau of Standards, was primarily designed to afford a means for measuring thickness of the oil film in the bearings of a large Navy turbine shaft. The device has a number of important applications: As a micrometer, a phonograph pick-up, a microphone, a thermometer, and for similar purposes.

The electronic micrometer designed at the Bureau utilizes the fact that radio frequency energy radiated from a coil is at zero at the surface of a perfectly conducting shield adjacent to that coil. This phenomenon occurs because eddy currents are set up in the shield by the field of the radiating coil, and these eddy currents set up an opposing magnetic field at the surface of the shield. The opposing field exactly cancels the incident field at the surface of the metal plate. Theoretically a pick-up coil of zero thickness applied at the surface of the shield would receive no energy. It is, however, impossible to design a coil of zero thickness. Therefore, compensation for the necessary thickness of the coil has been included in the design.

When the pick-up coil is moved away from the shield, in the direction of the radiating coil, it picks up a certain amount of energy because the radiated field becomes stronger while the field set up by the currents of the shield becomes weaker due to the change in distance. This condition becomes more marked as the distance between the pick-up coil and the shield increases. This is true whether the distance between the pick-up coil and the radiating coil decreases or remains unchanged.

Because the metal background is not a perfect conductor and because the coil has measurable thickness, a minimum reading is obtained when the pick-up coil is in contact with the metal background. This condition is corrected by the addition of a third coil, which permits a zero reading to be obtained.

The radiating coil is fed a high frequency current. When the micrometer is held at some distance from any metallic object, the field from the radiating coil induces voltage in the secondary (or pick-up) coil, and this induced voltage is measured either on an oscilloscope or by an alternating current meter. The linear indication of the change in distance between the micrometer and the metal background is indicated on the meter or oscilloscope.

This principle can be employed in a variety of ways. Most obvious, perhaps, is its use as a micrometer. In this application, the coil assembly is mounted on a movable shaft in such manner that it can be caused to approach or recede from a metallic plate. The material to be measured is placed between the pick-up coil and the metallic plate and is pressed lightly between them. When the material is removed, the amount of current generated in the pick-up coil is an indication of the thickness of the material that occupied the space. The meter indicating the output of the coil is calibrated, not in current or voltage; but in thousands of an inch in order to give a direct measure of distance or thickness.

Capacitance micrometers, with which measurement is made of the thickness of a non-conducting film separating the micrometer from a conductive background, are well known. It is impossible, however, to use micrometers of this type where the conductive background is either inaccessible or cannot be defined accurately. Similarly, inaccuracies are likely to be introduced because of changes in the dielectric constant of the insulating film covering the metallic backing.

When the electronic micrometer was used to measure the displacement of a turbine shaft in its journal, four of the devices were spaced equally around the turbine shaft. This arrangement is so sensitive that a deflection of 1/100 in. of the center of a 6-in. shaft provides a 2-in. deflection of the center spot of a cathode ray tube. The micrometer is about ½-in. in diam by ¼ in. in length and is able to measure distances from zero to 0.02 in. Readings to 0.0001 in. are easily obtained. The indication on a meter is linear to within a fraction of 1 per cent.

When the electronic micrometer is used as a microphone, vibrations adjacent to the pick-up coil are created by a metallic diaphragm, and the movement of this diaphragm causes fluctuations in the output of the pick-up coil.

Another application of the device is the tachometer or speed indicator. In this case, the end plate of a flyball governor may be so mounted as to approach or recede from the pick-up coil as the speed of rotation of the governor increases or decreases. Still other applications of the electronic micrometer are feasible. It is obvious that it can be applied to any use where the variation in distance between the coil and a conductive plate may be used to produce an electric current that will vary in linear manner in accordance with the change in distance. ★★★

M. L. Greenough and the new electronic thickness gauge he designed.

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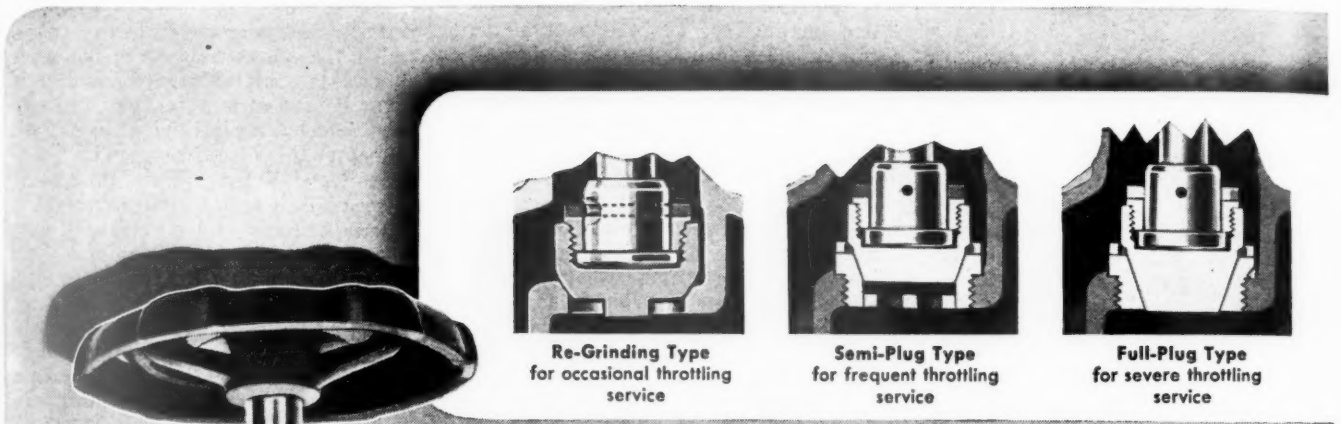

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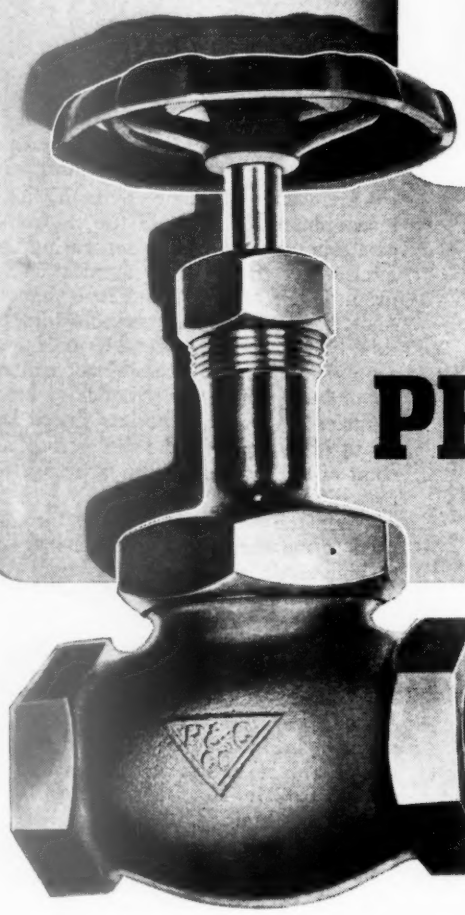
for severe throttling service



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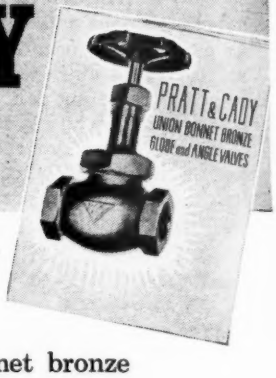

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TRADE MARK

Natural gas stored in buried pipe at 2240 psi

By C. R. CLAXTON,[1] M. G. MARKLE,[2] D. V. MEILLER[3]

THE Public Service Company of Northern Illinois recently placed in service near Kankakee, Illinois, a natural gas storage installation of a design developed in their organization consisting of 50 lengths of steel pipe, each 40 ft long and 24 in. in diam, and in each of which 25,000 cu ft of natural gas is stored at a pressure of 2240 psi. The 50 lengths have a total storage capacity of 1,250,000 cu ft.

This installation, although useful and necessary for continued reliable gas service to the Kankakee area, is also a "pilot plant" installed to demonstrate the advantages and determine any faults preparatory to making a much larger installation. The gas load of Kankakee and adjacent communities, with 9200 customers, is increasing rapidly because of the increasing population, greater use of gas for space heating, and an influx of new industries.

The normal supply of gas to the area is through a high pressure distribution feeder main from Matteson, Illinois, some 30 miles north and east of Kankakee. The distribution in the Kankakee area consists of a central low pressure natural gas system where a carburetted water gas plant with two 6-ft sets and a 500,000 cu ft commercial lift type holder are available for emergency use or peak shaving for the low pressure system only, there being no compressors for returning gas to the high pressure system serving the outlying areas and industrial customers. To assure, in the event of a temporary failure of the feeder main from Matteson, an emergency supply for high pressure customers and additional protection for the low pressure system, the additional storage of 1,250,000 cu ft in buried pipe was installed on the opposite side of the city from the normal supply through the feeder main from Matteson. The storage, together with the water gas plant and the lift type holder, can supply the maximum load of the area for the length of time that might be required to make emergency repairs to the feeder main from Matteson.

Of particular interest is the effect, in this type of storage, of the compressibility factor or the deviation from the laws of perfect gases of the natural gas stored. Fortunately, the maximum deviation occurs near 2240 psi and is of such magnitude as to increase the storage capacity by more than 40 per cent over that of a perfect gas, the compressibility factor "Z" (PV = "Z" NRT) being less than

1. Engineer, Process Division, Stone and Webster Engineering Corporation.
2. Gas engineer, Public Service Company of Northern Illinois.
3. Senior design engineer, Public Service Company of Northern Illinois.

Three-stage compressor for filling the special pipe has a capacity of approximately 6000 cu ft per hr.

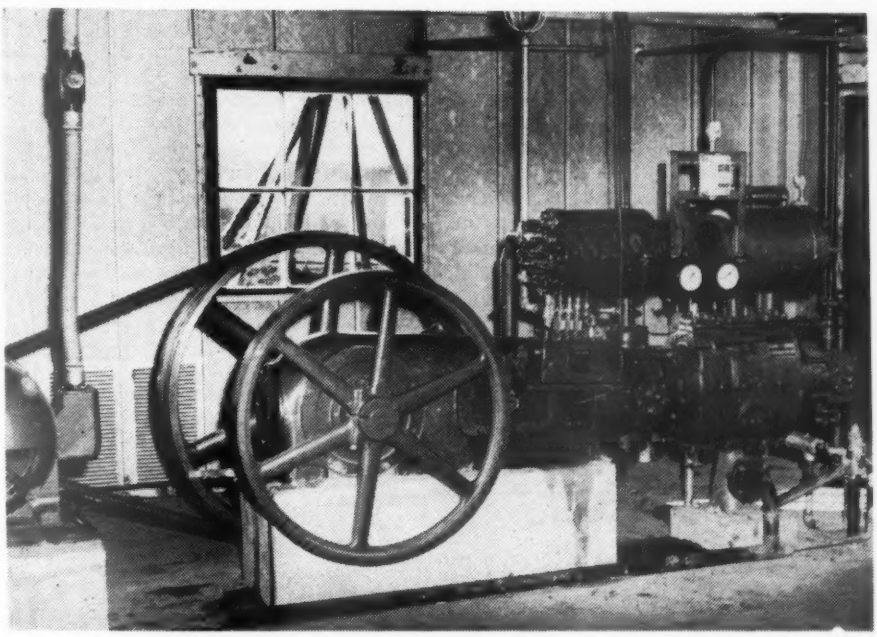
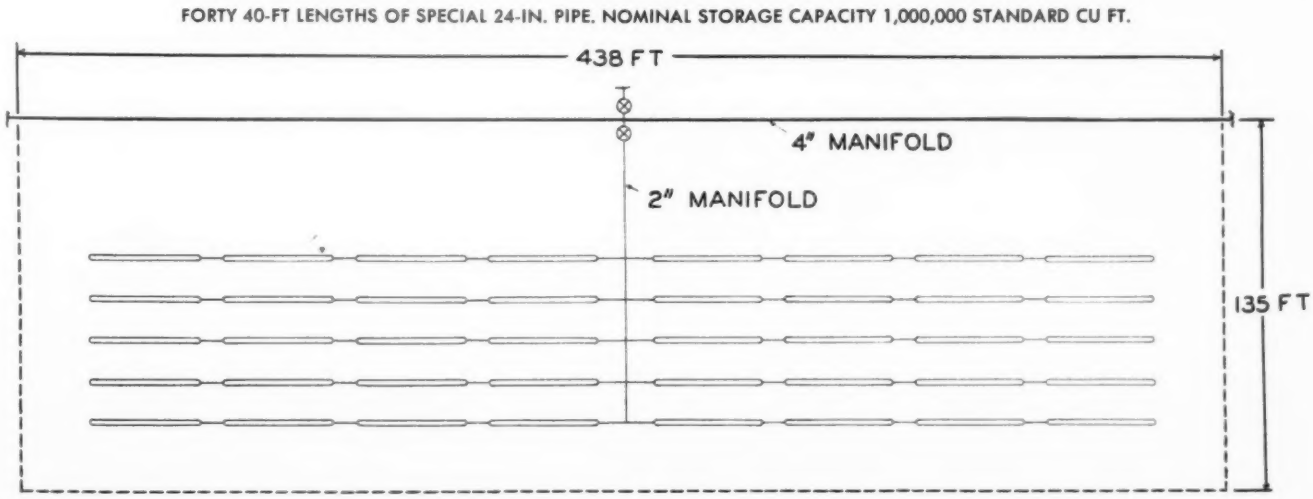


FIG. 1. General layout for storage of natural gas at 2240 psi in buried pipe.


FORTY 40-FT LENGTHS OF SPECIAL 24-IN. PIPE. NOMINAL STORAGE CAPACITY 1,000,000 STANDARD CU FT.
438 FT
4" MANIFOLD
2" MANIFOLD
135 FT

0.70 at 2240 psi and 40 F. Thus, whereas approximately 160 standard cubic feet of a perfect gas could be stored per cubic foot of space, approximately 230 std cu ft of natural gas can be stored per cubic foot of space. This was dramatically demonstrated when ten lengths of special pipe were pressured to 2300 psi with 187,000 cu ft. of air whereas 260,000 cu ft of natural gas was required to pressure the same ten lengths of pipe to 2240 psi. Also, a high pressure cylinder was pressured to 2240 psi with natural gas and the gas then carefully metered out in the laboratory. The metered volume was within 1 per cent of the calculated volume. The nominal storage capacity of the Kankakee installation is 1,250,000 cu ft, however, the actual gross storage capacity is 1,396,000 cu ft at 40 F storage temperature or 1,-184,000 cu ft at 60 F storage temperature. The net available gas from storage is approximately 25,000 cu ft less than the gross storage.

The operating presure of 2240 psi conforms to the A.S.M.E.-A.S.A. Code for Pressure Piping Section 2, Division 2, and is 80 per cent of the mill test pressure of 2800 psi. All piping other than the 24-in. special pipe conforms with Section 2, Division 1, of the Code for Pressure Piping. To withstand these high pressures, the special 24-in. OD seamless heavy wall pipe was made of A.P.I. N-80 steel, which has a yield point of approximately 80,000 psi. The pipe has a minimum wall thickness of 0.448 in. and weighs approximately 5000 lb per 40-ft length. In order to avoid field welding of the N-80 steel, each length of pipe, before shipment to the job, was swedged down on both ends, the ends rough bored, the pipe stress relieved and tapped on each end with a $1\frac{1}{2}$-in. thread to A.S.A. specification B 2.1, 1945 Appendix J. Each length was hydrostatically tested to 2800 psi in a water-filled jacket, which procedure permitted the detection of any pipe in which the yield strength had fallen below the minimum of 80,000 psi specified or any section of the pipe that was below the minimum specified wall thickness of 0.448. The 50 lengths of pipe installed at Kankakee averaged 39 ft $6\frac{3}{4}$ in. in length, and the average internal volume as determined by weighing when empty and when full of water was 109.66 cu ft.

The arrangement of the special pipe is shown in an accompanying illustration, which shows the spacing and arrangement of 40 lengths, which makes up a "standard" 1,000,000 cu ft unit of storage. The spacing between lengths of pipe was selected to facilitate installation, and so that a failure of any special pipe will not disturb adjacent pipes. The special pipes were spaced 8 ft end to end and 15 ft center line to center line. At Kankakee 40 lengths were installed, as in the illustration, and the other ten lengths were installed as a part of a future "standard" 1,000,000 cu ft unit. Two valves are installed in the field, one is a shut-off for the "standard" 1,000,000 cu ft unit, and the other is a shutoff for the 10 lengths of pipe that in the future may be a part of a second "standard" 1,000,000 cu ft unit. The special pipe has 3 ft 5 in. of cover to minimize seasonal temperature changes. All underground piping is coated and has cathodic protection.

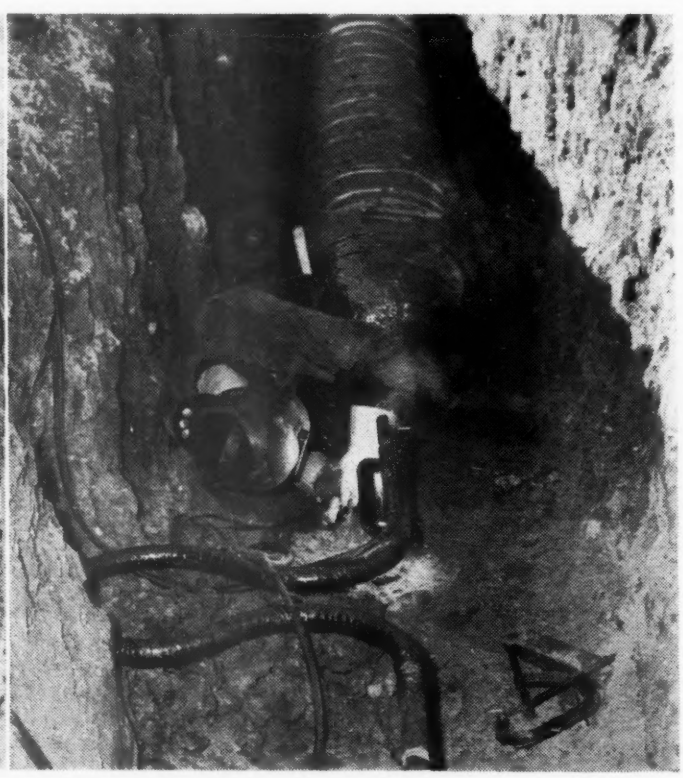
Oil field analyzer

The first oil pool analyzer to be placed in service was delivered to California Research Corporation, Whittier, California. The electronic device predicts future behavior of some West Coast oil areas.

The unit was demonstrated by W. A. Bruce, Carter Oil Company physicist and inventor, last year and plans and specifications were offered to the industry royalty free by Carter. The analyzer can develop in a few minutes the possible life history of an oil field.

The storage installation consists, in addition to the buried special pipe, of a compressor for filling the special pipe, regulators for withdrawing the gas, and a boiler and heat exchanger for heating the gas prior to pressure reduction. As this installation is primarily for emergency use, and quick refilling is not considered essential, the compressor was selected on the basis of availability rather than capacity. The compressor is three stage with intercoolers but no aftercooler, and has a capacity of approximately 6000 cu ft per hr at 40 psig suction pressure. A 40-hp motor drives the compressor with V-belts. The regulators and heat exchanger are designed for a withdrawal rate of 125,000 cu ft per hr. The regulation, which is in three steps, 2240 to 450 to 150 to 40 psi, has interstage receivers equipped with relief

Placing special pipe in the trench, left, and installing expansion bend between two lengths of pipe, right.



"Arc Booster" Simplifies AC Welding

Lincoln Electric announces new industrial type AC welder

A NEW heavy-duty transformer type welder, the "Fleet-Arc" has been introduced by The Lincoln Electric Company which improves AC welding by affording greater ease of arc striking, deeper penetration at the start, wider range of output, greater economy of operation and greater safety. It is applicable to a wide range of applications throughout industry.

A feature known as the "Arc Booster" gives the arc a burst of current the instant the electrode touches the work, starting the arc automatically. The current then returns in a fraction of a second to the amount set for the job. A selector switch provides adjustment of the booster current for any degree of arc striking intensity to suit the job.

Improves Penetration at Start

To improve penetration at the start of a bead, the "Arc Booster" of this new welder can be set to dig in with deep penetration. This is especially important for tack welds and short beads.

Improves Arc Characteristics

The welder has a reactor type of control which is a free circuit, designed for high responsiveness to changing arc conditions. It is separate from the main transformer which is designed for high efficiency. This design gives high arc sensitivity for maximum ease and speed of welding under all conditions; it makes possible an exceptionally wide range of output; and it improves power efficiency.

Current Adjustment is Continuous

The rotating reactor control provides step-less, smooth, accurate adjustment of welding current over the entire range of the welder. The operator simply turns a hand wheel. A double reduction chain drive makes it easy to turn the control and requires a minimum number of turns of the handle to cover the range. The amperage is indicated on a dial on the front of the welder.

The reactor current control is held in position by rugged cone brakes, preventing vibration and wear of the control mechanism.

Increases Safety

The open circuit voltage of the "Fleet-Arc" AC welders never exceeds 63 to 70 volts (depending on welder capacity). This eliminates the hazards of the high open circuit voltages which are used in the usual AC welders to improve arc striking.

Reduces Idle Power Consumption

The independent control circuit eliminates the need for high open circuit voltage, contributes to higher power factor. By reducing amount of condensers needed as much as 66%, this new welder minimizes idle power input.

Is Completely Self-Protected

A thermostatic device protects the windings of the welder from damage due to overheating, opening the welder's magnetic starter under such conditions. This feature permits the welder to be used at high current values for sustained periods without danger of burn-out.

Immediate Delivery

The new welders are available from stock in ratings of 200, 300 and 500 amperes. Complete information on the "Fleet-Arc" AC Welders is given in Bul. 366 which may be had by writing The Lincoln Electric Company, Dept. 422, Cleveland 1, Ohio.

Advertisement

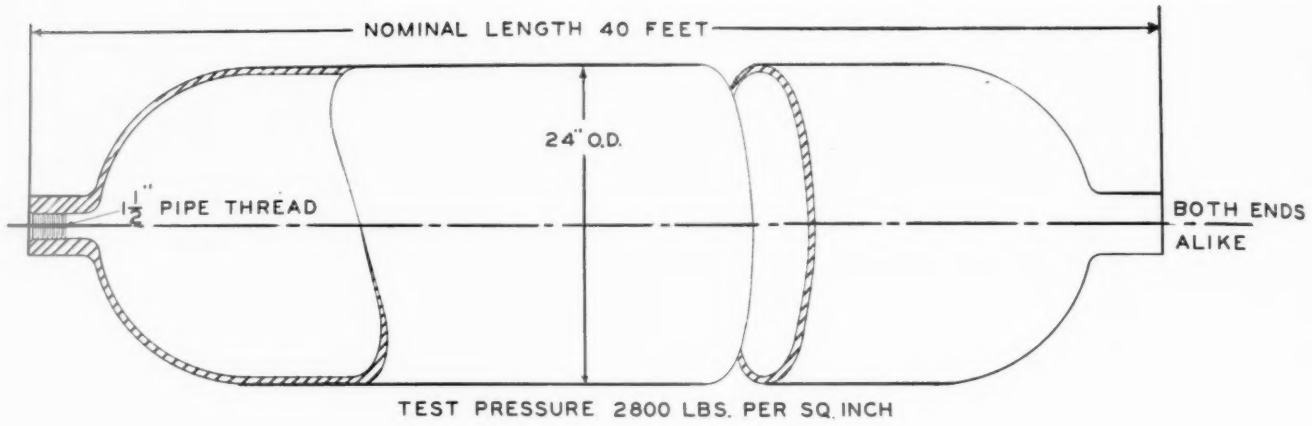
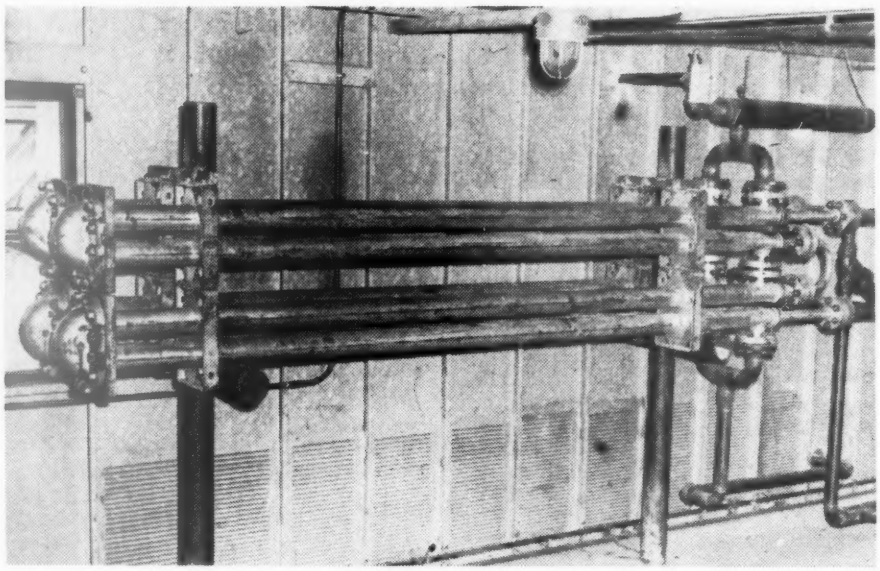
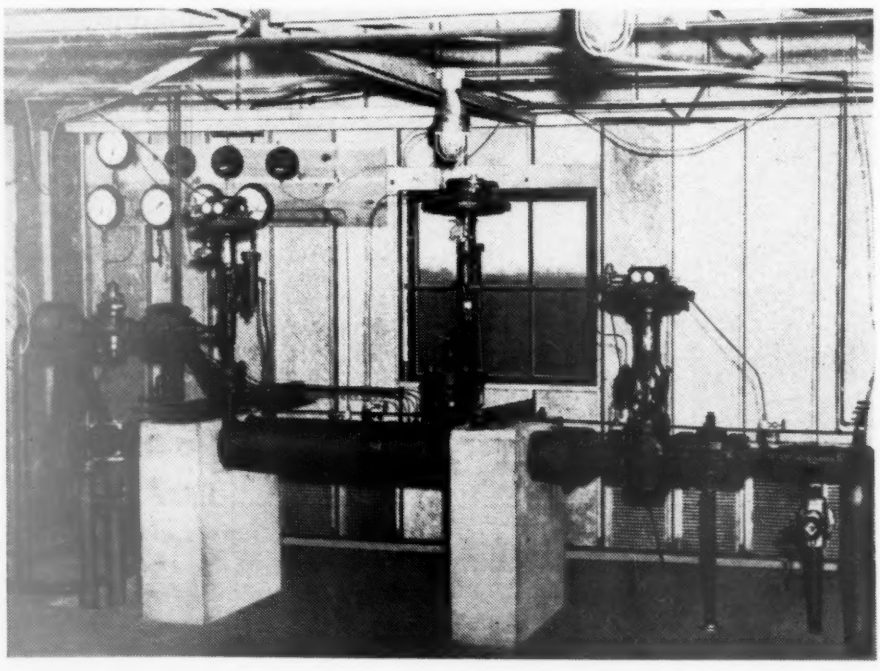


FIG. 2. Special seamless steel pipe.



Tube within tube heat exchangers used to heat high pressure gas with steam before reduction to distribution pressure.

Regulators reduce pressure in three steps, from storage pressure of 2240 psi to distribution pressure of 40 psi.



valves. "Choke run" bypasses around the first two stages permit maintenance of flow rate as storage pressure decreases. A cast-iron gas-fired boiler with 590,000 Btu per hr input provides low pressure steam for heating the gas ahead of the regulators.

Operating experience to date has been satisfactory. The piping was tested with air at full operating pressure prior to introduction of gas, in order to facilitate safe repair of any leaks. No leaks were found in the 1½-in. threaded joints in the ends of the special pipes. These threads and the 1½-in. male threads of the 1½-in. expansion bends connecting the special pipes were accurately cut and were carefully gauged with special gauges, both at the mill and in the field, and field "make-up" of these joints was carefully supervised. Sample threaded joints had been tested previously and found tight under 3000-psi gas pressure. Only one leak was found in a weld and no leaks were found in ring gasket flanged joints. A number of leaks were found at threaded joints made with "ordinary" pipe threads. Almost all such joints were then back-welded to insure tightness. Although no aftercooler was used, the temperature of the special pipe rose very little during filling. During a test in which the storage pressure was reduced 1200 psi in about 2 hr, the temperature of the gas in storage decreased about 30 F.

This type of storage has certain features to recommend it. As major facilities are underground, they are not subject to storm damage, are little influenced by atmospheric conditions, and there is no hazard to or from aviation. Because storage is in many small units, storage capacity may be added easily in any increments desired, and any unit may be taken out of service for repair or inspection without disturbing the remainder. A high percentage of stored gas is instantly available at distribution pressure. The investment, operating costs, and maintenance costs are very attractive.

It is anticipated that the flexibility and obvious features of this type of storage will make it quite popular for certain locations and conditions. ★ ★ ★

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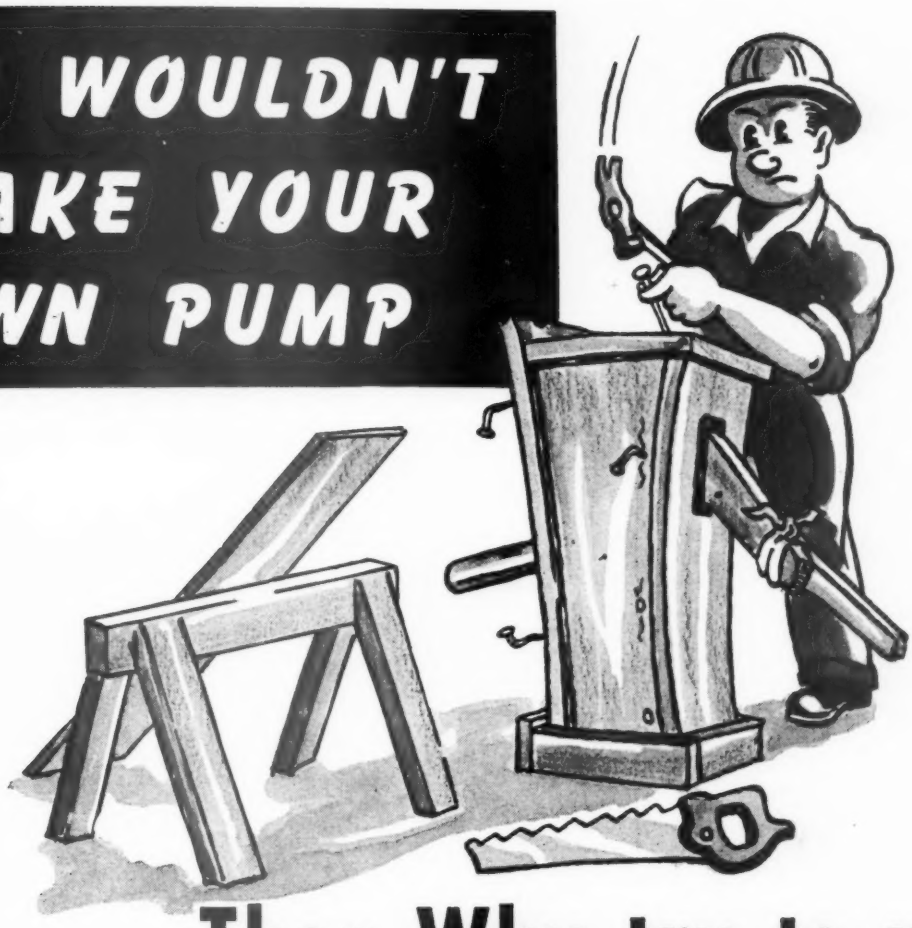
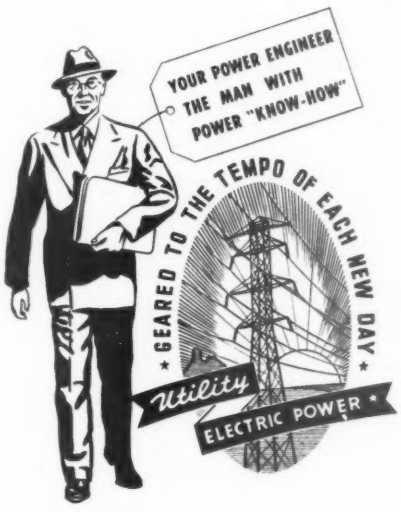


Then Why try to make your own Power



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Selection of multi-cylinder gas engines

By **FRED E. HUMMEL,** Shell Oil Company, Inc.

EXCLUSIVE

SELECTION of multi-cylinder gas engines for oil-well pumping unit service has become an important problem in oil-field pumping operations. Before considering the various makes, types, and sizes of gas engines and their application to the numerous types of pumping unit installations, it is necessary first to consider the prerequisites to economical gas engine operation.

A volume of 11-13 cu ft per bhp-hr of suitable gas at a minimum pressure of 8-12 in. of water or 4-6 oz (which corresponds to gasoline level in carburetor) is necessary at the location. It is well to determine the Btu content, for a gas with 900-1200 Btu per cu ft will operate satisfactorily with standard carburetor equipment whereas gas containing less than 900 Btu per cu ft usually requires special carburetor equipment.

Suitable scrubbing equipment is required to remove all water and foreign material from the gas. Water usually will make its presence known by stalling the engine but dust and foreign material will go through the engine and even in small quantities cause excessive wear and damage to all working parts. For example, a gas engine pulling a 40-hp load 24 hr per day will consume approximately 4,200,000 cu ft of gas per year. If the gas contains as little as one grain (1/7000 lb) of dust or foreign material per cu ft then 600 lb per year will go through the engine. For the same reason it is necessary to thoroughly clean the air entering the carburetor by using the best type of air filter.

A supply of clean soft water for the cooling system is necessary. Water suitable for drinking in most cases will be satisfactory for the radiator. If soft water is not available chemical treatment of hard water is required to prevent corrosion and scaling in the radiator and engine water jackets.

Trained crews provided with proper tools for repair and maintenance will prevent costly breakdowns and reduce operating costs to a minimum. Having provided for the necessary repair and maintenance crews, satisfactory water and suitable clean gas supply, the first step in the selection of each engine is to determine the brake horsepower required for a given pumping job.

To calculate the required gas engine horsepower, it is necessary to know the approximate volume of fluid to be lifted from a given depth. The horsepower may then be calculated from the following:

THE AUTHOR

Fred E. Hummel was graduated from the South Dakota School of Mines and Technology in 1931 with a B.S. degree in metallurgy. He was employed by the American Smelting and Refining Company as a metallurgical engineer until 1935. At this time, he received his M.E. degree for research work conducted on electrolytic gold, platinum, and paladium refining. Since then he has been employed by the Shell Oil Company, Inc., and has worked as general foreman and in the engineering department on drilling, production, and general engineering problems.

$$\text{Hp} = \frac{\text{depth in ft} \times \text{b/d} \times 350 \times \text{sp gr of fluid}}{33{,}000 \times 1400 \times \text{efficiency}}$$

Using 1.0 as specific gravity of fluid and assuming the total lift of fluid as the pump depth, then:

$$\text{Hp} = \frac{\text{depth in ft} \times \text{b/d}}{135{,}771 \times \text{eff.}}$$

or

$$\frac{\text{depth in ft} \times \text{b/d}}{136{,}000 \times \text{eff.}}$$

The efficiency used in the above formula is the overall efficiency from the subsurface pump to the prime mover and in general will range from 40 per cent on an average well to 70 per cent on wells with low gas-oil ratios or where large volumes of water are produced. Tubing and casing or liner size as well as gas fluid separating equipment below the pump affect the overall efficiency. Experience on wells with similar conditions and equipment will serve as a guide in estimating the efficiency of the well to be equipped with pumping unit.

Where pumping equipment is installed on a new well an estimate of the amount of fluid can be made from formation tests, bailing tests, and by comparison with similar adjacent wells where production volume is known; however, if test pumping equipment is available a production test will show the amount of fluid to be pumped and thus permit a more accurate selection of gas engine prime mover size.

Production to be expected from wells that have produced by flowing, gas lifting, etc., is usually known from potential tests and horsepower calculations can be made as shown.

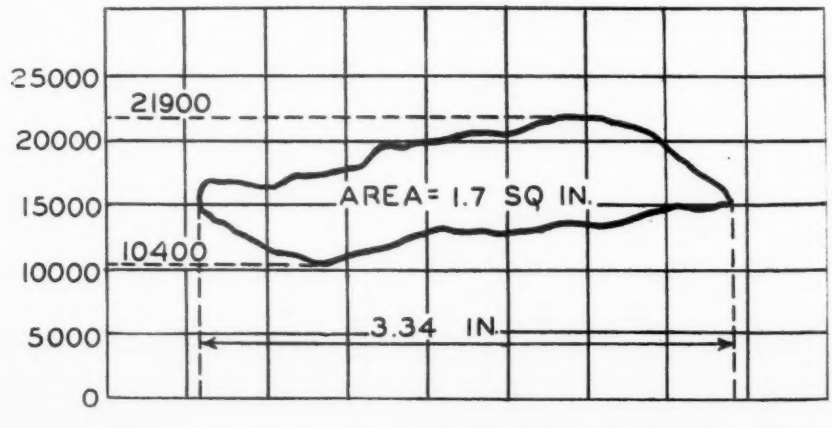
When electric motors are to be replaced with gas engine the horsepower may be calculated from input power to motor, or in case of other types of prime mover replacement, such as single cylinder gas engines, steam engines, etc., a polished rod dynamometer card may be taken and horsepower calculated as follows:

$$\text{Polished rod hp} = C \frac{A}{L} \frac{(\text{spm} \times \text{length of stroke, (ft)}}{33{,}000}$$

FIG. 1. Polished rod dynamometer card.

S.P.M. 16 Length of stroke 58 in.

Areat of card 1.7 sq in. Dynagraph constant 12,500 lb per in. of deflection.



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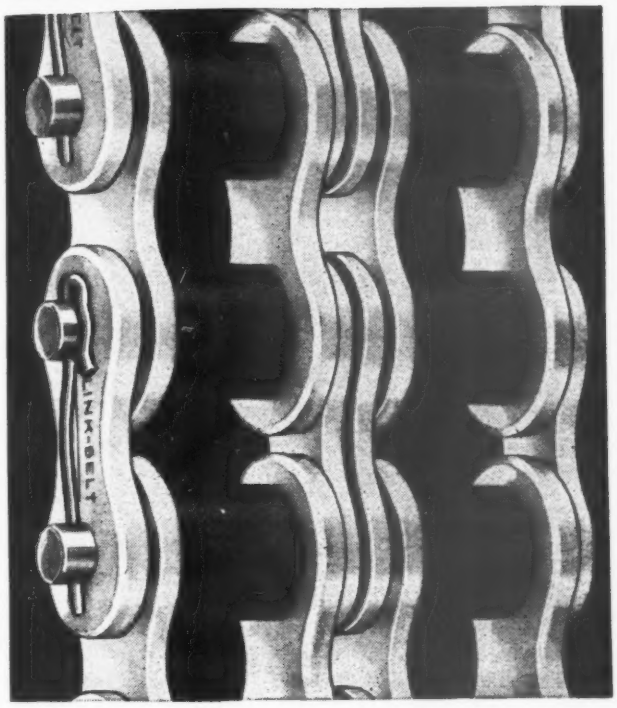

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Link-Belt Silverlink Roller Chain is made in accordance with Manufacturers' (A.S.A.) Standards, in all required sizes and widths, including sprockets. Alloy steel construction, great strength, light weight and ability to withstand shock has made it the top chain choice of operators and manufacturers alike.

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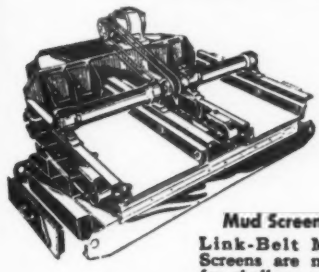

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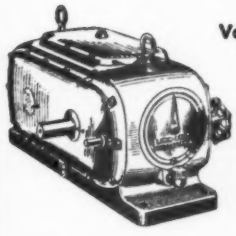

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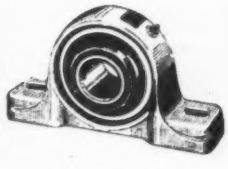

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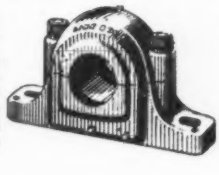

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In addition to the products illustrated, other Link-Belt oil field products include silent chain drives, couplings, collars, clutches, sprockets, pulleys and other mechanical power transmission machinery.

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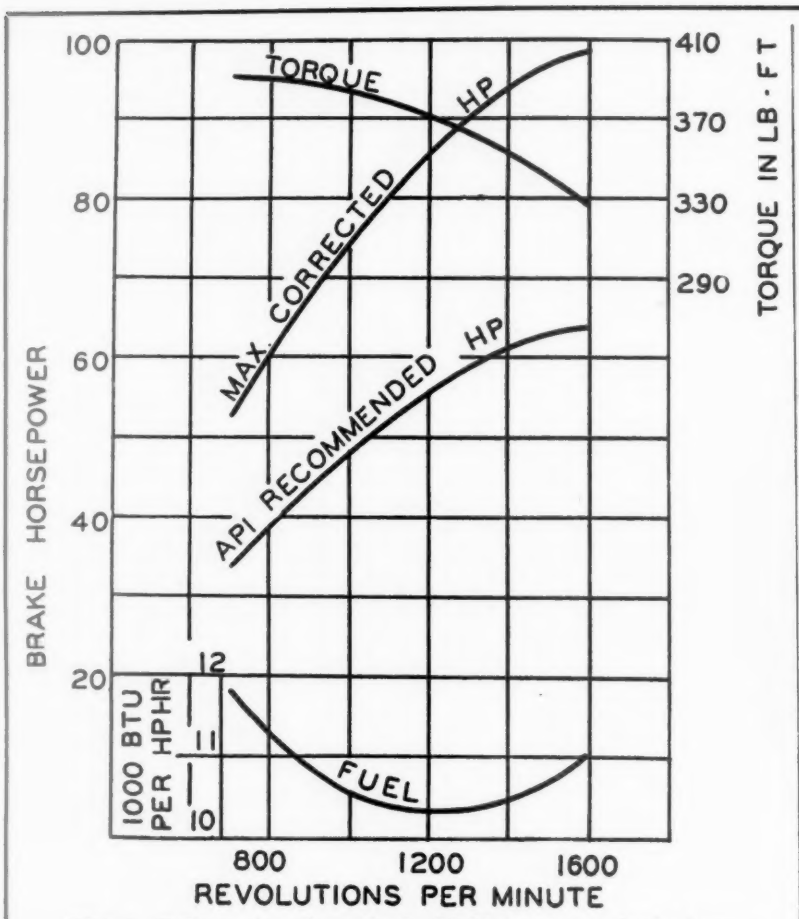

FIG. 2. Fully equipped standard oilfield power unit brake horsepower rpm curve for 4⅝ in. by 6 in. for 605 cu in. gas engine.

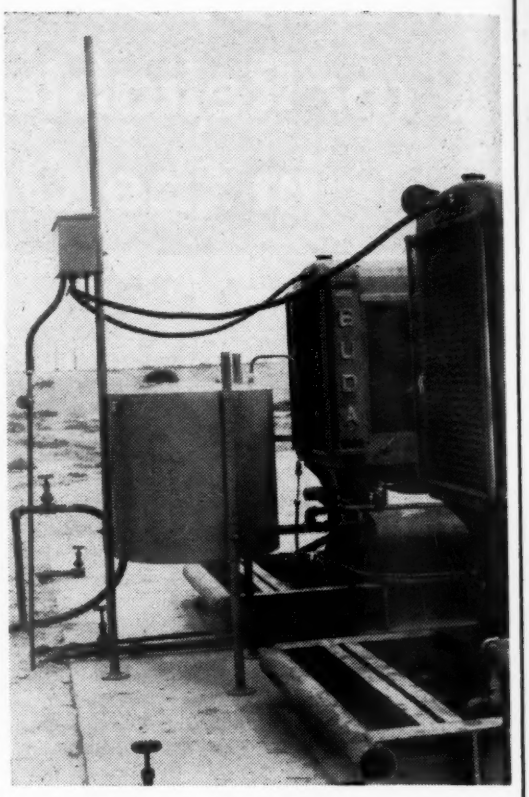

FIG. 3. Automatic oil and water level controller.

Where:
C = dynagraph constant, lb per in. of deflection,
A = area of dynagraph card,
L = length of dynagraph card, in.

Polished rod hp for dynagraph card (Fig. 1)

$$= \frac{12{,}500 \times 1.7 \times 16 \times 4.83}{3.34 \times 33{,}000}$$

= 14.9, say 15 hp

Taking into account pumping unit efficiencies that average approximately 80 per cent, a brake horsepower of 17.5 would be required to supply 15 polished rod hp.

Actual field experience indicates the best gas engine operating conditions are obtained when the engine is operated at 900-1000 fpm piston speed and 60-65 bmep. For the required horsepower the engine size may be calculated from the following formula:

$$Hp = \frac{PLAN}{33{,}000}$$

Where:
P = brake mean eff. press., psi,
L = length of stroke, ft,
A = area of cylinder, sq in.,
N = number of firing strokes per min,
Hp = brake horsepower.

Converting LA to total engine displacement the formula becomes:

$$D = \frac{Hp \times 792{,}000}{R \times P}$$

Where:
D = displacement, cu in.,
Hp = brake horsepower,
R = revolutions per min,
P = brake mean effective press., psi.

The engine size may also be selected from the engine manufacturers' power curves for standard power units and natural gas fuel. The API recommended horsepower curve is 65 per cent of the maximum corrected horsepower curve. (See API Std. 11-C Internal Combustion Engines and Clutches for Oil Field Services.)

The next step in engine selection after determining the displacement or size of engine needed to provide the required horsepower at the proper speed, is to select the make of engine.

The selection of engine should not be made on price alone and the various makes should only be compared on the basis of oil-field power units fully equipped to perform the required job. Water temperature and oil pressure cut-off switches, oil filter, and oil bath air cleaner, as well as suitable enclosures for weather protection are all part of the necessary equipment. If the engine is to be started with service truck batteries then a starter and cable connection receptacle are needed.

If the engine is to operate where inflammable gases or vapors are present spark-proofing of magneto, wiring, spark plugs, and exhaust is necessary and an engine must be selected that is readily adapted to this type of equipment.

Availability of parts is an important factor in engine selection and it is obvious that several makes of engines in one field or area only complicates the repair and maintenance problem. For standardization of one make of engine in a field the initial selection should be made from a line of engines having available all sizes necessary for future pumping installations.

When engine selection is made to drive pumping units on wells whose horsepower requirements are known to be constant the engine selection may be made as previously described. Most pumping unit engines, however, are required to supply additional horsepower at various times, such as additional

☆ ☆ ☆

A war-developed chemical compound forms an invisible "raincoat" over plastics, glass, paper, textiles, and other objects so that they shed water as easily as a duck. Recent tests in which 100,000 gal of crude oil passed through a flow meter whose glass surface had previously been treated with the compound revealed that the glass had been unaffected even after a 10-day period.

Baash-Ross News

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OUR 27th YEAR

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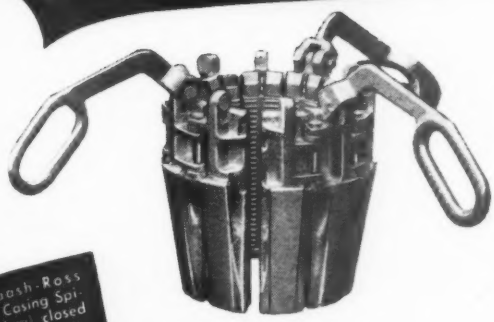

(The Baash-Ross Hinged Casing Spider (below) closed and ready for use. Split Spider Bushings (right) lock in place to adapt Spider for smaller pipe sizes. Baash-Ross Type "UC" Casing Slips (top) are recommended for handling casing 7⅝" O.D. and larger. For smaller pipe use Baash-Ross "DU" or "2M-B" Rotary Slips.)

A Universal Casing Spider that meets every Casing Handling Requirement!

The BAASH-ROSS HINGED CASING SPIDER

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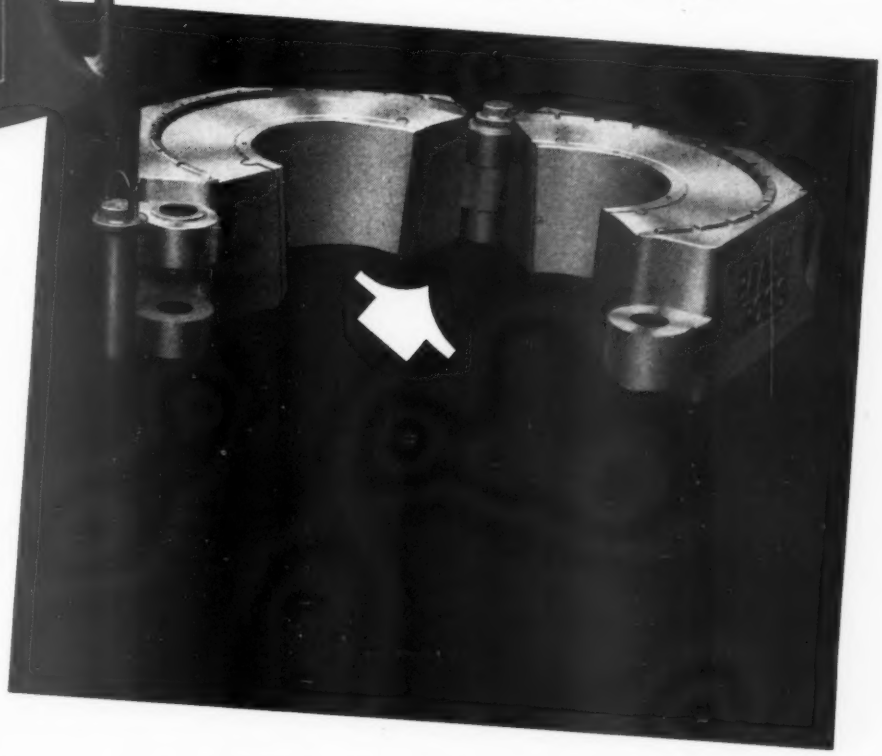
- You can place it directly on top of any type or size rotary table for supporting casing strings too large to be run through standard rotary master bushings. No need to remove the rotary table, no wasted time disconnecting the table drive and then reinstalling and realigning the table hook-up.
- Or, if preferred, you can use the Hinged Casing Spider on a platform that replaces the rotary machine.
- Or on workover, salvage and other operations where no table is installed, the Hinged Spider can be supported directly on cribbing, thus providing a quick and convenient method of handling casing and other pipe.



MAXIMUM CASING ADAPTABILITY

Wide-range installation adaptability is only *one* of the features in the Baash-Ross Hinged Casing Spider, for it is equally adaptable to handling a complete range of pipe sizes 18⅝" O.D. and smaller.

The Spider is made in *four* basic sizes . . . 18⅝", 16", 13⅜" and 10¾" . . . and each basic size will not only handle the diameter of casing corresponding to its size designation, but can be readily adapted to handle any smaller size of casing by simply inserting removable Spider Bushings.

These Spider Bushings are split and are retained solidly in place whether the Spider is open or closed. And regardless of the basic size, each Casing Spider can be bushed down, if desired, to the bore and taper of a standard rotary master bushing, thus permitting the use of standard rotary slips for handling small casing as well as any other pipe sizes that can be supported in regular rotary slips.

Get full details on this new Baash-Ross Hinged Casing Spider from your nearest Baash-Ross representative—or write direct for additional data.

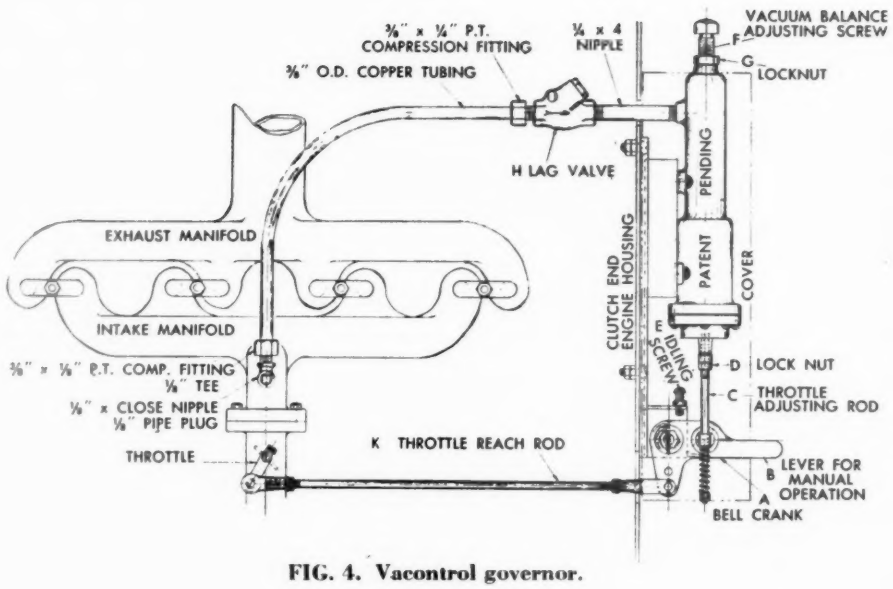


FIG. 4. Vacontrol governor.

pumping unit speed required for pump down periods after shut down for subsurface repair, additional pumping speed required as subsurface pumps wear, etc. For this reason some additional horsepower over the average requiremnt is advisable and its magnitude will depend upon conditions in the local field or area. Experience indicates that the engine should be operated under sufficient load to maintain normal operating temperatures and the additional horsepower over the normal requirements should be held to a minimum to prevent low operating temperatures. In areas where horsepower requirements diminish due to natural decline or increase due to production of additional water, it is advantageous to transfer engines rather than provide additional horsepower in the initial installation.

An important step in engine installation is the selection of engine V-belt sheave, which may be calculated as follows:

$$d = \frac{C \times R \times D \times S}{6F}$$

Where:

d = pitch diam of engine or driving sheave,

C = cycles per min of pumping unit,

R = gear ratio of pumping unit speed reducer,

D = pitch diam of driven or speed reducer sheave,

S = length of engine stroke, in.,

F = piston speed of engine, ft per min.

After installation work has been completed, the engine should be oiled and greased, the radiator filled with water, crankcase filled to operating level with a good grade of lubricating oil, the engine started and brought up to operating temperature before starting the pumping unit. After the well has pumped for sufficient time to reach average conditions, the pumping unit should be rechecked for proper counterbalance, and observations made of the gas engine speed and the intake manifold vacuum. The engine temperature should be maintained between 170 and 190 F to prevent condensation of water in the crankcase. Water in the crankcase usually results in sludge that destroys the lubricating properties of the oil and accelerates rapid wear of the bearings and all moving parts. Analysis of crankcase oil usually will indicate conditions leading to sludging before serious oil deterioration occurs and in addition will indicate excessive wear by the presence of metallic fragments, etc.

Various methods have been used to maintain proper engine temperatures. Most engines are equipped with thermostats placed between the engine head and radiator. The thermostat is usually installed so that it prevents the water from circulating or bypasses the heated water into the block until the engine reaches the proper operating temperature. Radiator shutters thermostatically operated control the engine temperature by regulating the volume of air drawn through the radiator by the fan. Thermostatically controlled variable pitch fan blades have been successfully used in localities where day and night temperatures vary widely.

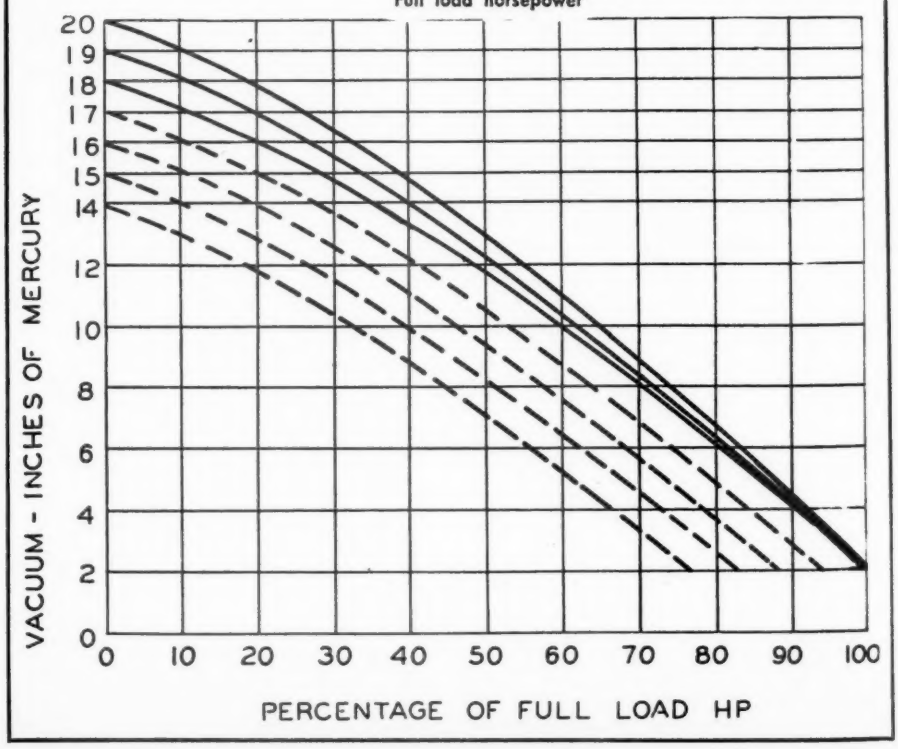
Oil sludging has been reduced and, in some cases, entirely eliminated by use of a heated base pan in which the oil temperature is maintained at approximately 165 F. A bypass thermostat controls the oil temperature by permitting part of the hot engine water to circulate through the jacketed crankcase. Thus oil temperature as well as block temperature are controlled, resulting in decreased engine wear and less frequent oil changes.

Oil consumption in gas engines varies

FIG. 5. Manifold depression curve.

DISPL	R.P.M. 700	800	900	1000	1100	1200
605	52	60	66	73	80	85
425	38	42	48	54	59	63
403	38	39	44	50	55	60
284	20	26	31	35	39	43
186	15	17	19	22	24	26
165	14	16	18	20	21	22

Full load horsepower



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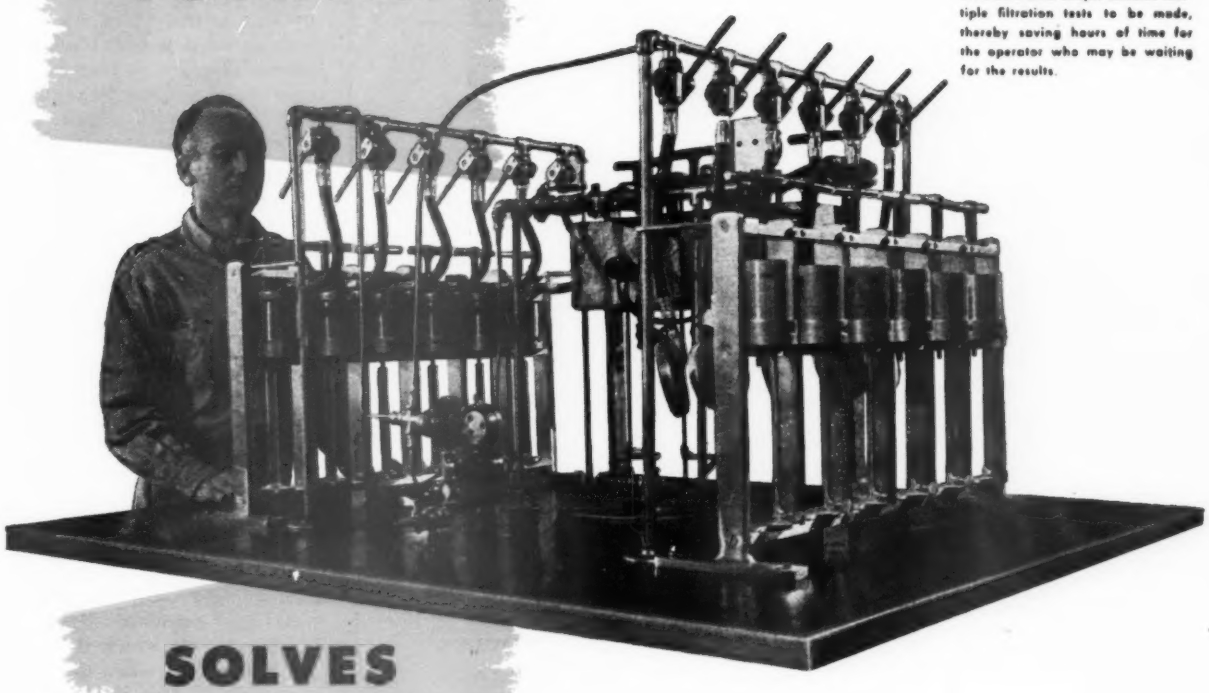

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greatly according to the engine wear and general conditions, such as bearing clearance, piston and ring fit. The oil is usually checked once each day and sufficient oil added to carry over a 24-hr period. This method results in excessive oil consumption during part of the day when the oil level is above that required for normal operation. A device for maintaining automatically a constant oil level in the crankcase and water level in the radiator is shown in Fig. 3.

In addition to savings made in actual volume of oil consumed, maintenance labor costs are reduced by eliminating the time required to make daily additions of oil and water.

The engine rpm should be checked while operating the pumping unit at the desired cycles per minute. To obtain low maintenance costs and the most economical horsepower output, the gas engine must be operated at the recommended speed. When well conditions require a permanent change in pumping unit speed it is best obtained by V-belt sheave changes so that a change in engine speed will not be required.

Engine speed is usually controlled by a hand throttle or governor and in some cases by both. Pumping unit maintenance requires frequent disengagement of the engine clutch and slowing the engine down to idle speed. It then becomes necessary for the pumper to check the pumping unit speed and reset the throttle to obtain the correct operating speed. Considerable saving in pumper's time may be realized by regulating the engine speed with an intake manifold vacuum controlled governor (See Fig. 4).

This device acts as a torque governor by controlling the carburetor butterfly valve with a spring balanced piston actuated by the intake manifold vacuum. When the clutch is disengaged the engine automatically slows down to idle speed and automatically returns to the exact speed at which it was previously being operated, when the pumping unit is restarted. This device stops the engine when the rods part, the well sands up, or when the pumping unit gets out of balance.

A good indication of engine load may be obtained from vacuum readings taken at operating speed under load and at the same speed without load and referring to the manifold depression curve (Fig. 5).

Records of maintenance and operating costs are essential to economical gas engine operation. These records not only indicate actual costs, but promote decreased costs by permitting a preventive maintenance program based on previous cost experience.

Total operating and maintenance costs per horsepower hour vary inversely with engine size but for gas engines from 10 to 100 hp output using 1000+ Btu per cu ft of gas at 16 cents per M cu ft the average cost should not exceed 2.5 mills per hp-hr.

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Some practical aspects of water flooding operations

By **HALBERT M. McCLAIN**

Magnolia Petroleum Company

THE injection of water into an oil-producing reservoir is for the primary purpose of increasing the ultimate oil recovery above what has been obtained by past primary production methods. In the past, the injection of water, which is commonly referred to as water flooding, has usually been applied after every mechanical means has been used in producing oil by primary methods. The inauguration of a water flood usually involves three steps: (1) Preliminary investigation, (2) development, and (3) operation of project.

Although there have been failures, water flooding, in general, has been successful and economical. The successful water floods are the result of having:

1. Sufficient sand to flood.
2. Reservoirs with satisfactory water flooding characteristics.
3. A planned economic flooding program.
4. Received an ample price for the produced oil to pay expenses resulting in a net profit.

Water flooding projects that failed usually had unsatisfactory reservoir flooding characteristics resulting in low water flood oil production, the value of which, under prevailing economic conditions at the time, could not pay out the cost of the projects. Present methods of studying reservoirs in many cases could have detected the unsatisfactory reservoir characteristics, resulting in utilizing a different flooding program, and/or they probably would not have been put in operation.

The primary production of leases that have and are being water flooded in Oklahoma, Kansas, and the eastern fields were usually from 3000 to 6000 bbl of oil per acre. Water flood oil production from the successfully completed floods equals or exceeds the primary production. In North Texas the primary production of individual leases is in general lower per acre than in some of the other areas that have been flooded. This condition is the result of having thinner sand reservoirs. Consequently, to avoid water flooding failures in North Texas, both from the standpoint of oil production and economics, it is essential that each individual project be evaluated completely before they are inaugurated. Such evaluations should utilize all the past primary producing and reservoir data that are available for consideration.

Oklahoma, Kansas, North and West Central Texas have 88,000 stripper wells, one-fourth or 22,000 of which are in North and West Central Texas.† It is apparent that the possibility of water flooding in West Central and North Texas is enormous and will require considerable work to develop engineering data to select properly the leases that can be flooded successfully and economically.

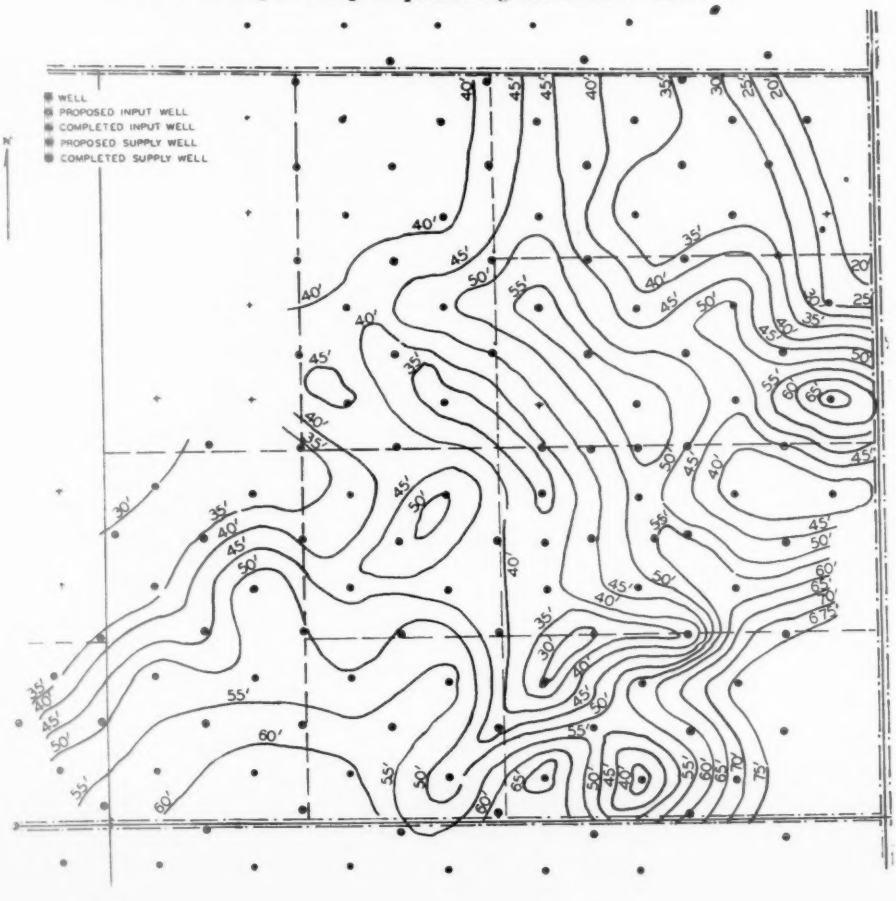
Leases or fields that are being studied for water flooding under present economic conditions in North Texas should meet certain generalized specifications:

1. The reservoir should be:
   a. Gas expansion type.
   b. A blanket sand.
2. Viscosity of oil should be relatively low, 15 centipose or below.
3. Leases should have produced very little water during their primary production life.
4. Wells can be 2000 ft in depth or less.
5. The 2000-ft wells should have at least 25 ft of permeable productive sand, or more, while 500 to 1000-ft wells should have at least 12 to 18 ft of sand.
6. Porosity of sand should be about 18 per cent or more, and the per-

*Presented before the North Texas Oil and Gas Association, Annual Secondary Recovery Meeting, Wichita Falls, Texas, March 8, 1947.

†E. G. Dahlgren, National Stripper Well Survey 1945. Presented before the Interstate Oil Compact Commission December 10, 1946.

FIG. 1. Isopach map of producing formation—Lease A.



THE AUTHOR

Halbert M. McClain has charge of secondary production operations, including both gas repressuring and water flooding, salt water disposal, and chemical engineering, in the production department of the Magnolia Petroleum Company, Dallas, Texas. After receiving his degree from Oklahoma A. & M. College in petroleum and chemical engineering McClain worked in the Mid-Continent area from Illinois to the Gulf Coast and from Louisiana to New Mexico. He had experience in all phases of drilling and production engineering as applied to both primary and secondary production operations. McClain is a member of API and AIME and is a registered professional engineer.

TABLE 1. Preliminary production data, Lease "A", Magnolia Petroleum Company.

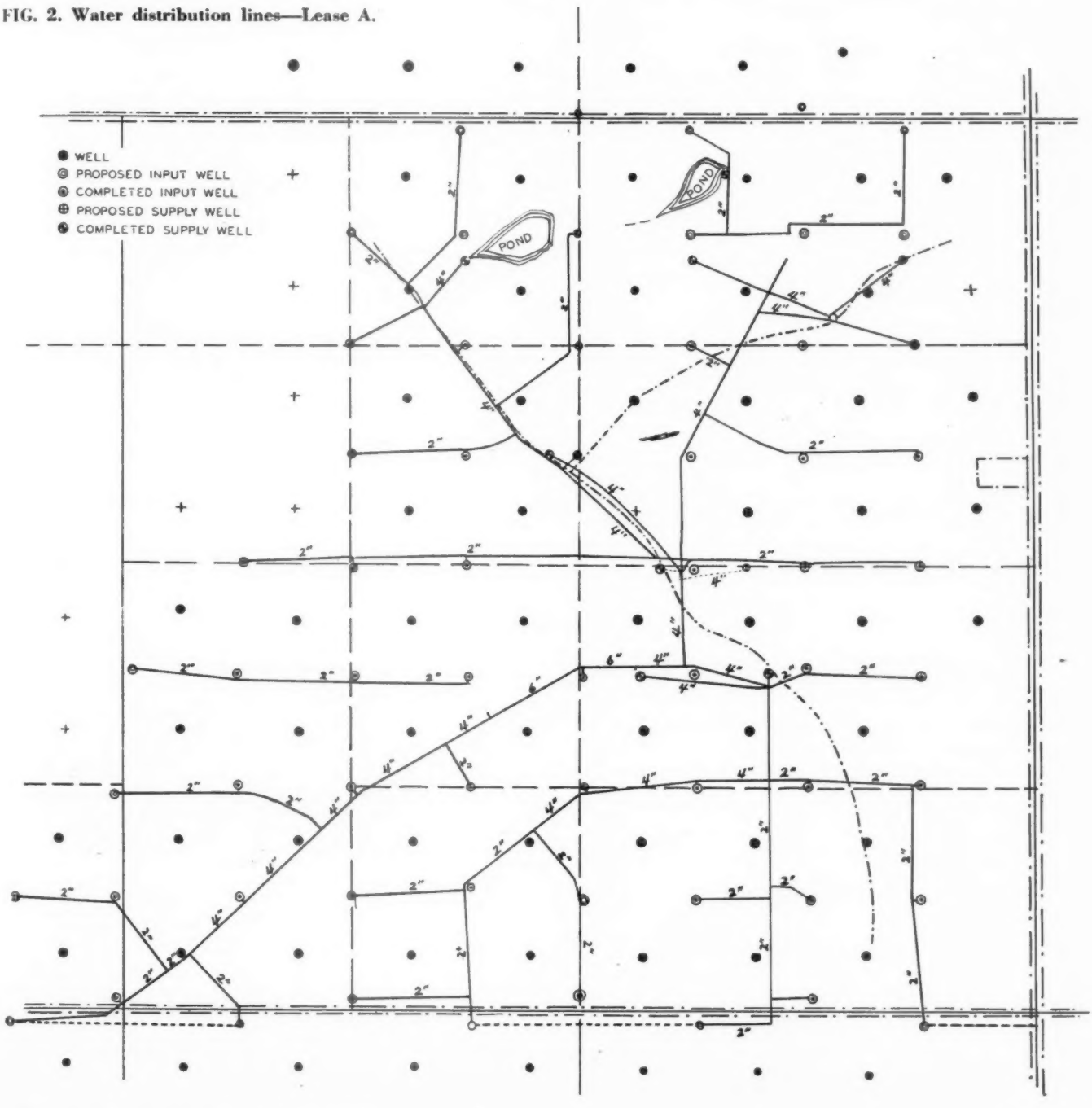
Producing sand	Bartlesville
Number producing wells	54
Average total depth, ft	1,975
Average sand thickness, ft	60
Estimated average porosity, per cent	20
Approximate gross production start to January 1, 1942, bbl	3,549,000
Productive acres	540
Average gross barrels per productive acre	6,572
Approximate future total gross oil reserve under normal operation, bbl	354,000
Approximate future gross oil reserve per acre under normal operation, bbl	540
Estimated future total gross oil reserve by water flood	2,700,000
Estimated future gross oil reserve per acre by water flood	5,000
Increase in gross oil reserve per acre by water flood	4,360

meability, regardless of magnitude, should be relatively uniform.

7. Accumulated past primary oil production should be equivalent to 25 or 30 per cent or less of the theoretical total void space in the reservoir while allowing 30 per cent for connate water.
8. Particular attention should be paid to the method wells have been plugged and abandoned in the past to ascertain, if possible, whether or not the leases might be watered out by the slow encroachment of water in the reservoir from improperly plugged wells.
9. Water supply in the area—preferably subsurface salt water—should be ample to carry on a complete water flood program.

● **Preliminary field investigation.** *Primary production data.* The data that were utilized and developed for a recent water flood, which is known as Lease A in this article, are presented to illustrate the procedure followed and the factors considered while making a preliminary study of a water flood program. Table 1 presents the preliminary production data for the entire project. The important data in Table 1 is the Gross Primary Oil Production—3,549,000 bbl of oil or 6,572 bbl of oil per acre. Also it is indicated that Lease A should produce only an additional 354,000 bbl of oil under methods being used prior to water flooding. Ordinarily a reservoir with suitable flooding characteristics will produce by flooding a volume of oil comparable to the primary production. To maintain a conservative evalution, it was estimated that Lease A should produce about 75 per cent of its primary production or 5000 bbl of oil per acre—

FIG. 2. Water distribution lines—Lease A.



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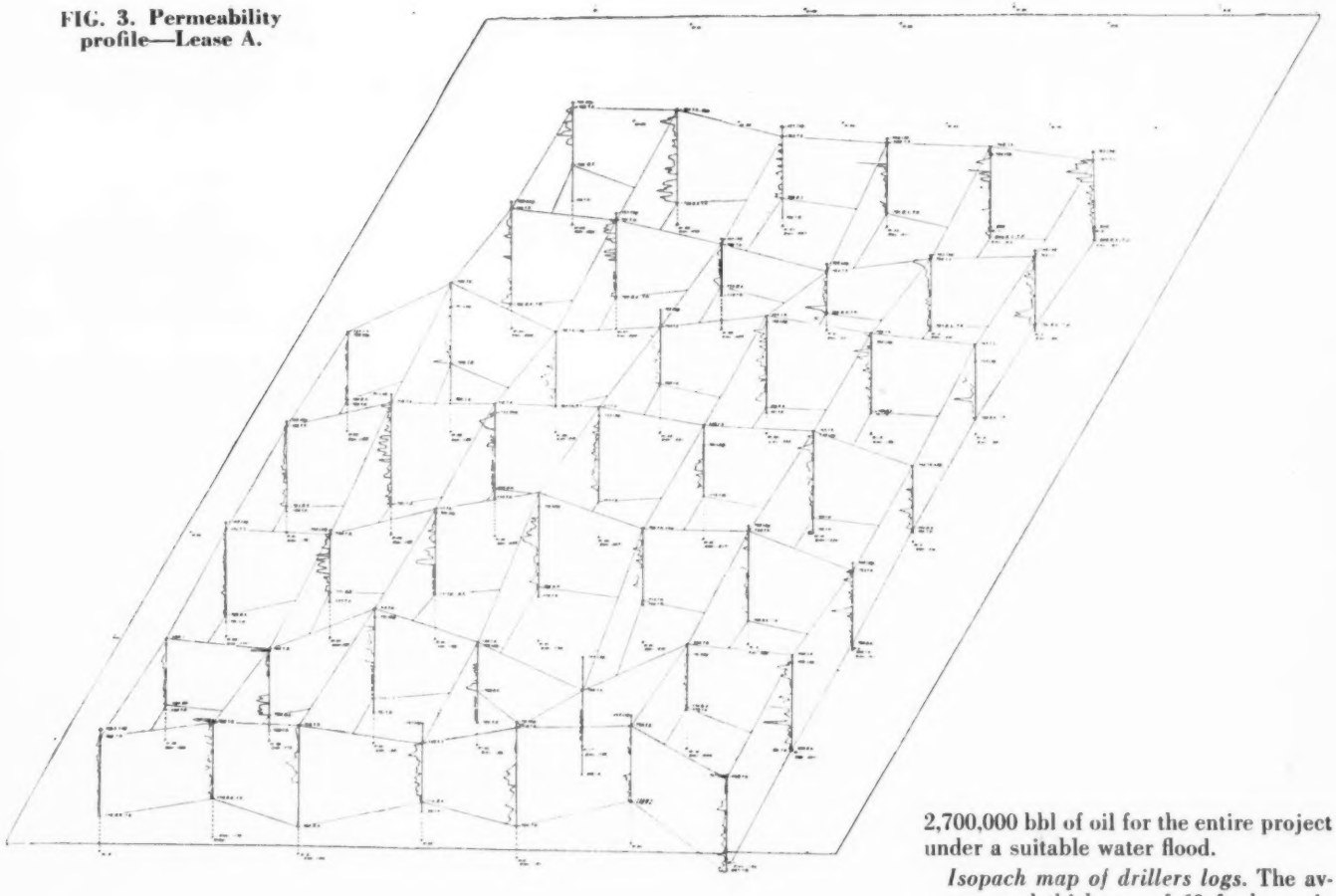

FIG. 3. Permeability profile—Lease A.

TABLE 2. Exhibit "C". Interest factors, Lease A.

	Producing wells		Developed acreage		Gross cumulative production		Six mos production, bbl		Average interest factor, per cent
	No.	Interest factor	Acres	Interest factor	Bbl to 6-1-42	Interest factor	Ending 6-1-42	Interest factor	
Company "A"	7	0.1272727	80	0.1454546	383,412	0.1080303	991	0.0831655	11.598
Company "B"	8		80		581,993		2,211		
	2		20		56,180		330		
Total	10	0.1818182	100	0.1818181	638,173	0.1798119	2,541	0.2132426	18.917
Company "C"	2		20		164,724		418		
	8		80		529,421		1,608		
Total	10	0.1818182	100	0.1818181	694,145	0.1955826	2,026	0.1700235	18.231
Company "D"	2	0.0363637	20	0.0363637	164,724	0.0464126	418	0.0350790	3.856
Company "E"	4	0.0727273	40	0.0727273	331,297	0.0933464	1,171	0.0982712	8.427
Company "F"	15	0.2727272	130	0.2363636	875,867	0.2467846	3,828	0.3212487	26.928
Company "G"	7	0.1272727	80	0.1454546	461,497	0.1300316	941	0.0789695	12.043
Grand total	55	1.0000000	550	1.0000000	3,549,115	1.0000000	11,916	1.0000000	100.000

TABLE 3. Summary of core analysis data, wells drilled for pilot flood, Lease A.

	Well no. 1	Well no. 2	Well no. 3	Well no. 4	Well no. 5	Average
Depth	1961-2014	1945-75	1965-83	1954-89	1927-70	
Per cent core recovery	89.0	86.0	100.0	88.7	90.0	90.7
Feet of permeable productive sand recovered	42.0	25.8	17.0	34.8	43.3	32.5
Average permeability, millidarcys	18.0	23.0	30.0	23.0	34.0	25.6
Capacity, average permeability by feet productive sand	756.0	593.0	510.0	800.0	1472.0	826.2
Average porosity, per cent	18.6	18.3	21.0	19.7	19.0	19.3
Average residual oil saturation, per cent pore space	21.1	26.6	18.5	66.2	26.7	31.8
Gravity of oil, °API	42.0	42.0	42.0	42.0	42.0	42.0
Average total water saturation, per cent pore space	54.8	53.3	61.9	21.6	52.3	48.8
Viscosity, centipoise	2.7	22.5	2.8	2.7	2.7	2.7
Drilled with	Rotary	Rotary	Cable tools	Cable tools	Rotary	
Type drilling fluid	Mud	Mud	Mud	Oil	Mud	
Weight, lb per gal	10.0	9.8	9.8	from	9.8	
Funnel viscosity, seconds	55.0	45.0	45.0	reservoir	55	
Water loss cc/30 min	30	Less than 0.6	Less than 0.5		4	
Initial gel, grams	50	10	10		10	

2,700,000 bbl of oil for the entire project under a suitable water flood.

Isopach map of drillers logs. The average sand thickness of 60 ft shown in Table 1 was determined from the isopach map Fig. 1 that was prepared while using old drillers well logs. Although the isopach map represents the reservoir as it was originally drilled, subsequent drilling and coring of input wells throughout the lease proves definitely that the productive sand consisted of only about 50 per cent of the total section drilled as being productive.

General layout of project. When all the available production and reservoir data were considered, it was evident that the leases should respond satisfactorily to water flooding, and warranted further study. Consequently, for consideration, the general layout of the entire program was developed as shown in Fig. 2. The water input and supply wells were located on the lease with their respective surface elevations. Grades for all distribution lines were laid out, and the size of all pipe and equipment was determined for the project, after which complete estimates of costs were prepared for use in evaluating the economics of the project.

The water supply is obtained from 1100-ft salt water producing wells. The wells were drilled with rotary tools to total depth, where 8-in. casing was set on top of the sand. The first three water supply wells were spaced on regular ten-acre locations. It was observed when the third supply well was put in service that the producing capacity of the other two wells (1000 bbl per day per well) was affected. Therefore, the spacing of water supply wells was increased to one well

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This complete rig is the lowest in cost, the highest in quality, longest in life, fastest in drilling speed and lowest in moving expense of any comparable rig in the world. ***Ask any owner for proof of these statements.***

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Model S single engine draw works with Lee C. Moore mast

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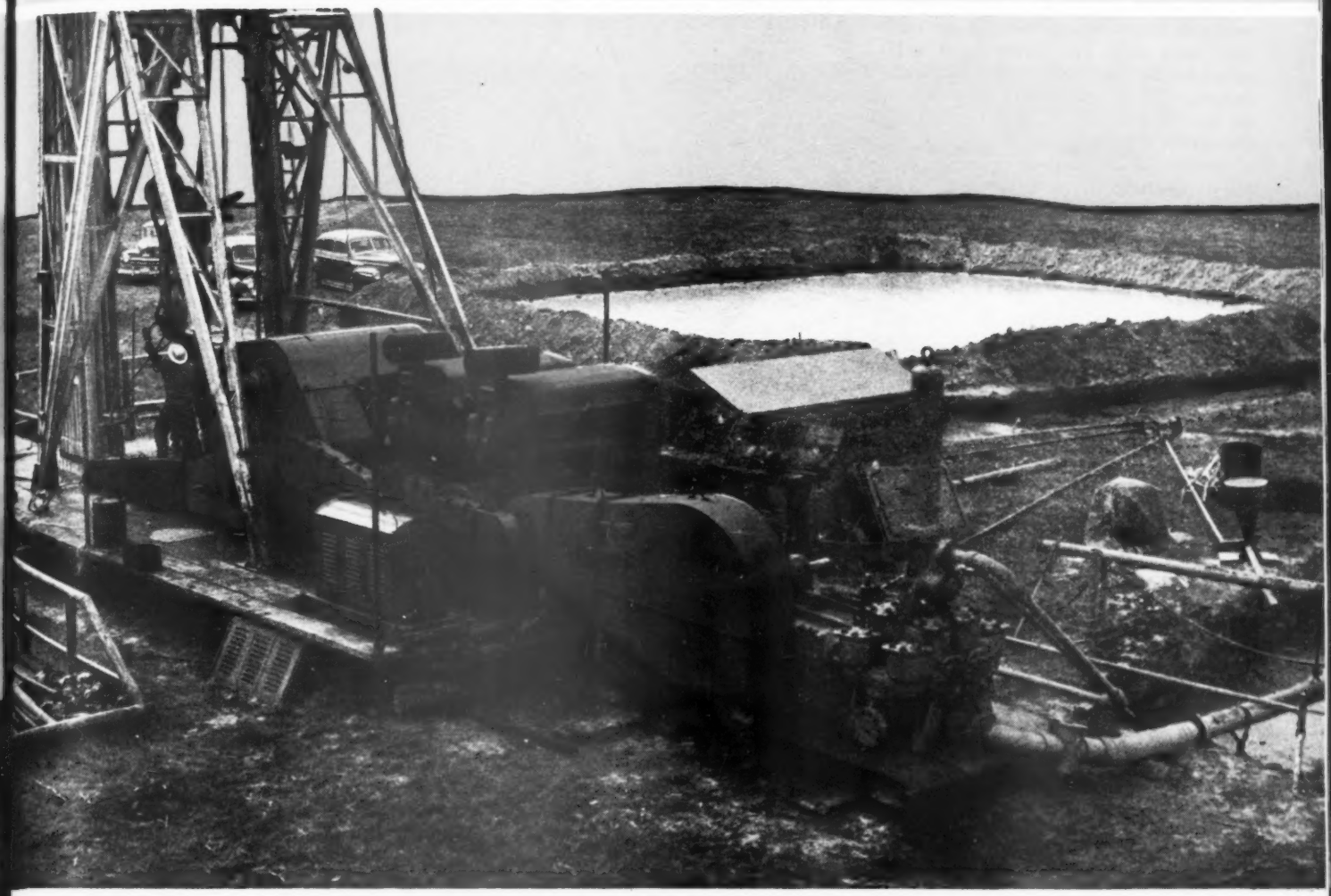

Cardwell Model O Twin-Engine Draw Works with Lee C. Moore Mast owned by Robinson Drilling Company, Fairfield, Illinois

"Cardwell" Model O twin-engine draw works with chain type compounding makes it possible to transport draw works without removing engines. It is standard with "Caterpillar" D13000 or Waukesha WAK engines, and optional with "Caterpillar" D17000, Waukesha NKU, Buda PCD-1879, or two General Motor "Twins." These larger engines are standard with V-belt drives. With "Caterpillar" D13000 or Waukesha WAK, this twin-engine draw works is practical for 6,000-foot drilling, and with the larger engines to 8,000 feet, when additional power is used on the pump.

The "Cardwell" Model S, shown at left, is a fast, powerful single engine draw works for 5,000-foot drilling, or 10,000-foot workover jobs. "Cardwell" air clutches speed up operations and make possible more work with less effort. The "Hi-Lo" drive, usable in all five speeds of the even-step transmission, provides a high drive for fast block return, and a low for picking up the pipe without shifting gears.

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to 40 acres. The supply wells are equipped with 4-in. tubing and rods and a 20-hp pumping unit.

The salt water is pumped through a separator and directly into the distribution lines to the input wells. The distribution lines include 6-in., 4-in., and 2-in. steel pipe. The water input well tubingheads include a manifold with suitable valves and meters to regulate the rate of water input, and the 2½-in. cement-lined tubing is set in the well on a packer in the bottom joint of the 5½-in. casing.

Unitization. The producing properties included in Lease A were originally operated as seven different leases. In order that the maximum efficiency of the proposed water flood could be realized whereby the highest possible ultimate recovery of oil could be obtained at a minimum development and operating cost for the individual companies the seven leases were unitized under one lease. The unit operating agreement provided that the project should be operated by one of the companies in the unit, with all the companies participating in all matters of the project on the basis of a fixed interest factor. The past production data that was used to determine the interest factor for each of the individual companies is as follows:

1. Total wells producing at time of unitization.
2. Productive acreage.
3. Cumulative oil production.
4. Current production as reflected through a recent six months producing period.

Each of the four classes of production data contributed equally to determine the average interest factor for each of the participating companies. Table 2 indicates the method used to determine the interest factor for each class of data as well as the average interest factor for the individual companies.

Experience while operating the unit has proved the method satisfactory, because it has eliminated all conditions that could exist under a cooperative program that would tend to create inequities and disagreement among the interested companies. All phases of the operating program of the unit have been considered and approved by each member of the unit in proportion to their interest in the unit and thereby they have contributed directly to the program resulting in a more efficient operation of the project.

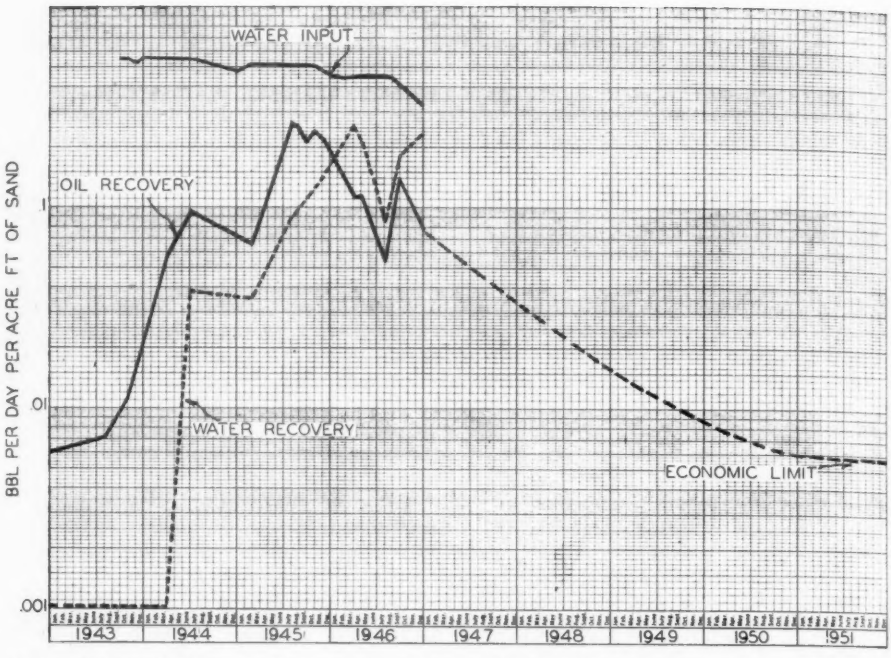


FIG. 4. Production and water input data—Lease A—composite curves pilot data.

Est. production 12-31-46	88,200 bbl
Est. recovery per acre 12-3-46	4,400 bbl
Est. recovery per acre-ft 12-31-46	133 bbl
Est. future production	24,700 bbl
Est. total production, 20 acres	112,900 bbl
Est. total recovery per acre	5,600 bbl
Est. total recovery per acre-ft	170 bbl
Water input per acre-ft Dec. 46	.3310 bbl
Oil production per acre-ft Dec. 46	.0838 bbl
Water production per acre-ft Dec. 46	.2150 bbl
Total	.2988 bbl

TABLE 4. Estimated water flood recovery calculations using core analysis data, five wells in pilot flood, Lease A.

Total pore volume (32.5-ft sand, 19.3 per cent porosity), bbl per acre	48,681
Water content (22 per cent), bbl per acre	10,710
Initial oil content, bbl per acre	37,971
Oil shrinkage (15 per cent), bbl per acre	5,696
Initial stock tank oil in reservoir, bbl per acre	32,275
Past production, bbl per acre	6,286
Present oil in reservoir, bbl per acre	25,989
Residual oil in reservoir after water flood (23.2 per cent), bbl per acre	8,809
Oil available for water flood, bbl per acre	17,180
Water flood production 50 per cent efficiency, bbl per acre	8,590

● **Development of project.** *Core analysis.* After completing the unitization program for Lease A, which consisted of 540 productive acres, the development of the pilot water flood, consisting of only 60 productive acres with six water input wells—spaced one well to ten acres—and one oil well to ten acres in the center of each of the two 5 spots, was begun.

The development program for the initial pilot flood, since the leases were already drilled up with one oil well to ten acres, consisted of drilling five input wells and the converting of one old oil-producing well to a water input well. Each of the five water input wells drilled were cored—wells Nos. 1, 2, and 5 with rotary tools and wells Nos. 3 and 4 with cable tools. The drilling and coring program of the five input wells included the use of various types of drilling muds in an effort to determine whether or not flushing of cores with the drilling fluid could be eliminated. Data developed from the coring program are included in Table 3 and indicate:

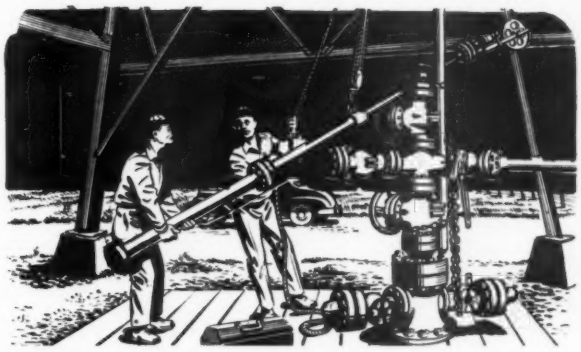
1. All rotary cores regardless of the type mud used were flushed with water from the drilling fluid.
2. Extremely low water loss muds (0.5 cc to 4 cc) reduced the extent of flushing because the residual oil in cores taken with high water loss mud.
3. Cable-tool cores taken with low water loss mud (0.5 cc) were flushed more than rotary cores taken with the same type drilling fluid.
4. Cable-tool cores taken with oil, although they were flushed with oil, indicated a normal water content in the reservoir.
5. Cable-tool cores taken with oil were flushed more than those taken with low water loss mud.
6. It is necessary to use both rotary tools with a low water loss mud and cable tools with oil to obtain sufficient and satisfactory core data to evaluate an oil producing reservoir.
7. The primary oil production from the area within which the Lease A pilot flood is located should be equivalent to about 19.6 per cent of the total void space in the reservoir.

Evaluating calculations. In order that an estimate could be made that would indicate what per cent of the original oil in place was represented by the past primary production, the average of all five core analyses was used to calculate total fluid content of the reservoir in the pilot flood area. The calculations used an average porosity of 19.3 per cent, 22 per cent connate water, 18 per cent oil shrinkage as shown in Table 3. It will be noted in Table 4 that the calculations estimated that the reservoir contained originally 32,275 bbl of stock tank oil per acre. The past primary production for the lease, Table 4, within which the pilot flood is located was 6286 bbl per acre. Therefore, it is estimated that the past primary production was equiva-

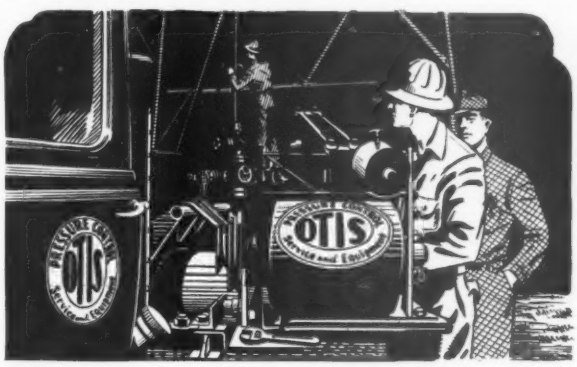
Previous installation of an Otis Type G Side-Door Landing Nipple makes 11,500 foot, 6350 p.s.i. job easy

as told

1 "An Otis wire line service crew was called to the Chocolate Bayou Field to assist the Blank Company in killing their John Doe No. 1. Depth was approximately 11,500 feet with a shut-in pressure of 6350 p.s.i. Due to difficulties encountered in killing this same well for a previous work-over, *the tubing had been equipped with a standard Otis Type G Side-Door Landing Nipple which provided four circulating ports* just above the packer which had been set at 11,500 feet.

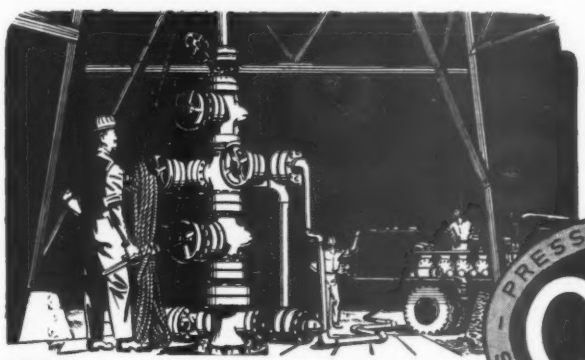


2 "A Type G Side-Door Choke Assembly had been landed in the Nipple to pack off the ports while the well was producing up through the bore of the Choke. *First, we installed our regular 10,000 p.s.i. test high-pressure lubricator on the top flange of the surface connections.* An Otis Type D Choke Extractor was run on a wire line, engaged to the Side-Door Choke Assembly, and both tools were flowed back up the tubing by well pressure to within 300 feet of the surface.



3 *"The well was then shut in and the Extractor and Choke pulled the remainder of the distance to the surface with an Otis Type B Pulling Tool.* Mud was pumped into the casing, circulated through the side ports in the Nipple, conditioned, and the well killed. To close the ports in the Nipple and allow pumping through the bottom of the tubing at 11,500 feet, we dropped the same Choke in the tubing at the surface . . .

4 ". . . and, with pumps circulating at 2000 p.s.i., pumped it to the top of the Landing Nipple in 23 minutes. This was indicated by an increase in pump pressure to 2600 p.s.i. *We then ran a 1" plug on wire line tools into the taper at the top of the Choke.* Pressure immediately increased to 3400 p.s.i., and forced the Choke to seat in the Nipple. Pumps were shut down, pressure released, and the 1" plug on wire line tools was pulled to the surface.



5 *"Thus, with the side ports in the Landing Nipple again packed off by the Choke, flow was directed down through the bottom of the tubing.* By taking strain on the tubing and maintaining pump pressure at 3000 p.s.i. the packer was easily pulled from its set position. Circulation was broken around it with 3200 p.s.i., mud was conditioned, and the packer pulled from the hole. Thus, foresight used by this operator in installing an Otis Type G Side-Door Landing Nipple, as part of the tubing string, resulted in a simple work-over of a deep, high-pressure well."

This is the second in a series of advertisements covering actual installations of Sub-Surface Controls and subsequent service as described by Otis Pressure Control, Inc., field personnel. Except for necessary deletion of company and trade names these reports are unedited. For further details on equipment and service, write Otis Pressure Control, Inc., 6612 Denton Drive, Dallas.

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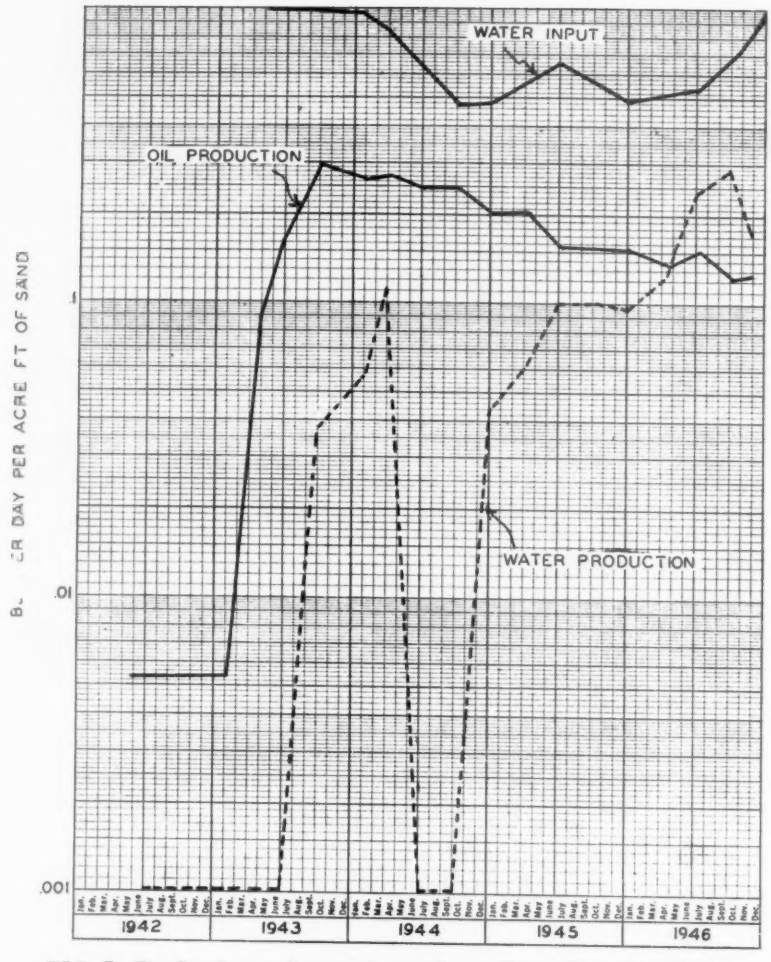

FIG. 5. Production and water input data—Lease B—pilot flood.

Water input per acre-ft Dec. 46	1.0370 bbl
Oil production per acre-ft Dec. 46	.1250 bbl
Water production per acre-ft Dec. 46	.1740 bbl
	.2990 bbl

lent to 19.4 per cent of the original oil, which agrees very closely with the 19.6 per cent obtained from core analysis data and calculations for wells Nos 3 and 4. Table 4 also indicates that the reservoir still contains about 17,000 bbl of oil per acre that is available for water flooding.

Permeability profile of reservoir. As the flood was developed through subsequent extensions of the original pilot flood, all water input wells drilled were cored for analysis. Fig. 3 presents a permeability profile of the entire reservoir as it has been drilled at this time. It will be noted that there is a wide variation in the permeability not only in each individual well but from well to well. Also, the profile, which might be considered comparable to an isopach map, does not resemble the isopach map Fig. 1 that was prepared from old drillers logs. Instead of having 60 ft of productive sand as shown on Fig. 1, the producing reservoir (Fig. 3) has only about 30 ft of permeable productive sand.

The profile of the permeability of the reservoir will be used throughout the producing life of the project along with other data to control water injection and the production of both oil and water. It also serves to indicate the relative permeability of each well and thereby provides a means of estimating oil recovery from the project.

● **Operations.** *Production tests.* The performance of a water flood is usually followed during its producing life by periodic production tests on individual oil-producing wells. The production test data are used along with water input data to indicate: (1) Past water flood production, (2) future oil production, and (3) whether or not the producing capacity of the wells is comparable to the volume of water being injected into the reservoir and thereby determine which water input wells, if any, are losing water to sources other than the producing reservoir.

Periodic production tests and water input for the Lease A pilot water flood are shown in Fig. 4. It is estimated while using Fig. 4 that the pilot flood of Lease A has produced as of 12-31-46 about 88,000 bbl of oil—4400 bbl per acre or 133 bbl per acre-ft. Also, it is estimated that the future life of the pilot flood will be approximately five years and should produce an additional 24,700 bbl of oil. resulting in a total of 112,900 bbl of oil for the 20-acre pilot flood—5600 bbl per acre or 170 bbl per acre-ft, which agrees favorably with the estimate of 5000 bbl per acre and the past primary production shown in Table 1.

It will be observed (Fig. 4) that the rate water was being injected early in the life of the project was about 0.5 bbl per acre-ft per day (5 bbl per foot of permeable productive sand) and the rate gradually declined especially after January 1, 1946. The maximum rate of 5 bbl of water per foot of sand was considered ample to maintain the proper velocity for the water to move through the sand. A higher rate of injection of water would obtain results quicker, but such rates would create conditions that would cause the water to bypass some of the oil in the low permeable streaks in the sand. Likewise the total fluid of the periodic production tests were increasing until January 1, 1946, at which time they began to level off and approach the volume of water being injected into the pilot flood. During December, 1946, the two oil-producing wells in the pilot flood produced a total of 0.298 bbl of fluid per acre-ft per day as compared to 0.331 bbl of water injected per acre-ft per day, which indicates that the pilot flood is in balance, in that the production of fluid is equivalent to the volume of water that is injected into the reservoir.

To illustrate how water input wells can lose water to a source other than the oil-producing sand, the production tests and water input data for a pilot flood on another project, which is comparable to Lease A and referred to as Lease B, is shown in Fig. 5. It is indicated that the flood on Lease B was very sensitive to changes in water input rates. The rate water was being injected early in the life of the project was about one barrel per acre-ft per day (10 bbl per ft of permeable productive sand). The production tests indicate that both oil and water increased rapidly and at the end of 18 months the high rate of water injection was reduced to about 0.5 bbl of water per acre-ft per day (5 bbl per foot of sand), resulting in an immediate reduction in water production and no excessive decline in oil production. After three months of low water production, the pilot flood began increasing in water production with a normal decline in oil production. During the month of December, 1946, about 1 bbl of water was injected per acre-ft of sand per day into the pilot flood, whereas only 0.299 bbl of fluid per acre-ft per day was produced during the same period. It is very evident that about 0.7 bbl of water per acre-ft per day (7 bbl per foot of sand) is being lost to some source other than the producing reservoir. Consequently, it is apparent that some remedial work should be done, if possible, on the pilot water input wells on Lease B, because the wells produced 0.299 bbl of fluid per acre-ft per day during December, 1946, by the injection under pressure of 1 bbl of water per acre-ft per day. The Lease A pilot flood during the same period produced 0.298 bbl of fluid per

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6A-5

acre-ft per day with the injection under gravity pressure of about one-third the water or 0.331 bbl per acre-ft of sand per day. It is important to note that the pilot flood on Lease A was receiving input water into the reservoir under gravity pressure at a rate of 0.331 bbl of water per acre-ft per day while the reservoir under Lease B was apparently receiving water at a rate comparable to the Lease A pilot flood, although a large volume of water was being injected into the well under pressure. Both pilot floods were producing about 0.3 bbl of fluid per acre-ft per day, although the volume of water injected into Lease B flood was three times larger than was injected into Lease A flood.

Water encroachment. The flood on Lease A is being developed relatively slow while injecting water at a slow rate, and it is important to observe the water encroachment throughout the lease. Fig. 6 was developed to estimate how much of the reservoir at subsequent periods of time had been filled with water. The six original pilot flood input wells, W-14, W-15, W-18, W-19, W-30, and W-31, are located in the SE¼ of the present developed acreage of the lease. The inner circle of the six pilot input wells (Fig. 6) represents the surface area around each well under which the reservoir was filled with water at the date (December, 1943) results from increased oil production were observed. The first 140-acre extension, which includes 14 water input wells immediately around the pilot water flood, was put in operation about two years after the pilot water flood was started. The inside circle of the first extension input wells and the middle circles of the six pilot flood input wells represent the surface area under which the reservoir has been filled with water as of January 1, 1946. The outer circles of the six pilot input wells, as well as the wells in the first extension and the single circles for all the other wells shown as being in water flood service, represent the surface area under which the reservoir is filled with water on January 1, 1947.

Fig. 6 indicates two important things in the operation of the water flood:

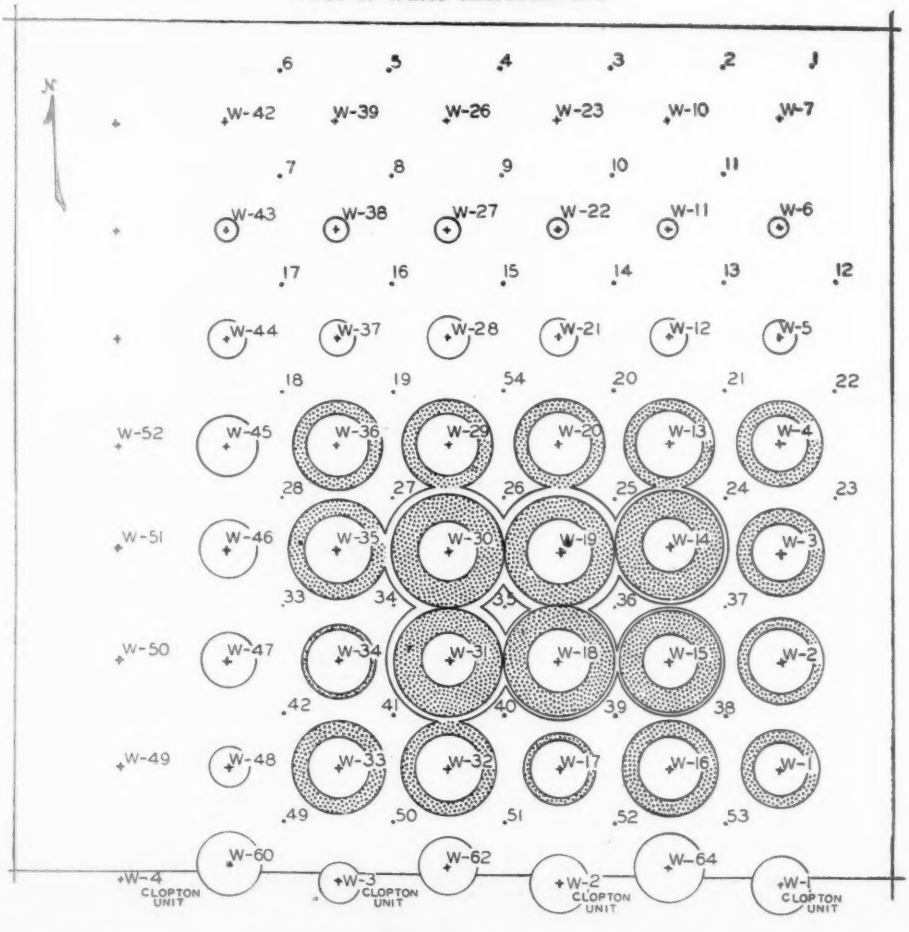
1. The area represented by the inside circles on the six input wells indicates approximately the volume of water necessary to be injected into the reservoir before results are obtained, and thereby the date to expect increased oil production from all subsequent extensions in the project can be estimated.

2. It indicates definitely that the flood is out of balance and emphasizes the necessity of starting the injection of water into all of the water input wells, as near as possible, on the same date.

The area filled with water within the pilot flood of Lease A, at the time results were obtained, was equivalent to 21.6 per cent of the volume in the reservoir included within the boundary of the six water input wells. A similar map, which is not shown, for the pilot flood on Lease B indicated that sufficient water had been injected at the time results were observed, to fill 56 per cent of the reservoir included within the boundary of the four water input wells. Likewise, a similar map for a Lease C indicated that only 18.6 per cent of the reservoir was filled with water at the time results were apparent.

Lease A was operated on a ten-acre spacing while injecting at about 5 bbl of water per foot of sand. Lease C is

FIG. 6. Water encroachment.



Legend for Fig. 6.

Maximum production tests.

Well number	Date	Bbl of oil	Bbl of water
18	3-17-46	1.5	0.5
19	9-18-46	30.0	2.0
20	9-11-46	38.0	7.0
21	9-12-46	10.0	2.0
22	9-13-46	2.0	0.5
23	10- 2-46	3.0	10.0
24	8-18-46	43.0	44.0
25	6-18-46	115.0	20.0
26	8-13-46	88.0	72.0
27	7-19-46	45.0	20.0
28	3-14-46	2.0	0.0
33	9-26-46	46.0	1.0
34	9-24-46	53.0	62.0
35	5-11-46	36.0	140.0
36	8-22-46	57.0	37.0
37	12-10-46	42.0	166.0
38	12-15-46	70.0	23.0
39	12-23-46	5.0	17.0
40	3- 7-46	30.0	44.0
41	9-25-46	86.0	58.0
42	3-17-46	1.0	0.0
49	3-15-46	1.0	0.0
50	3-17-46	1.0	0.0
51	12-29-46	83.0	5.0
52	12-25-46	145.0	3.0
53	12-24-46	65.0	10.0

Estimated area flooded by water, acres.

Well number	Date results obtained in pilot flood	January 1, 1946	January 1 1947
W- 1		1.88	4.29
W- 2		2.28	4.99
W- 3		2.14	4.67
W- 4		1.95	4.67
W- 5			.74
W- 6			.27
W-11			.29
W-12			.90
W-13		2.64	5.28
W-14	1.88	7.18	9.46
W-15	1.93	6.27	7.17
W-16		2.55	5.81
W-17		2.17	3.19
W-18	2.41	7.49	9.31
W-19	2.66	7.66	10.51
W-20		2.75	5.24
W-21			.83
W-22			.28
W-27			.43
W-28			1.14
W-29		2.54	5.13
W-30	2.15	8.10	10.66
W-31	1.98	7.82	10.11
W-32		2.78	6.04
W-33		2.31	5.70
W-34		2.51	3.31
W-35		2.94	6.27
W-36		2.59	4.98
W-37			.75
W-38			.39
W-43			.37
W-44			.83
W-45			2.42
W-46			2.15
W-47			2.03
W-48			.86
W-60			2.70
W-62			2.13
W-64			2.98
W- 1			2.25
W- 2			2.23
W- 3			1.05

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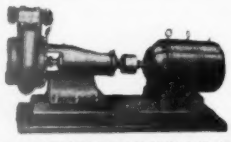

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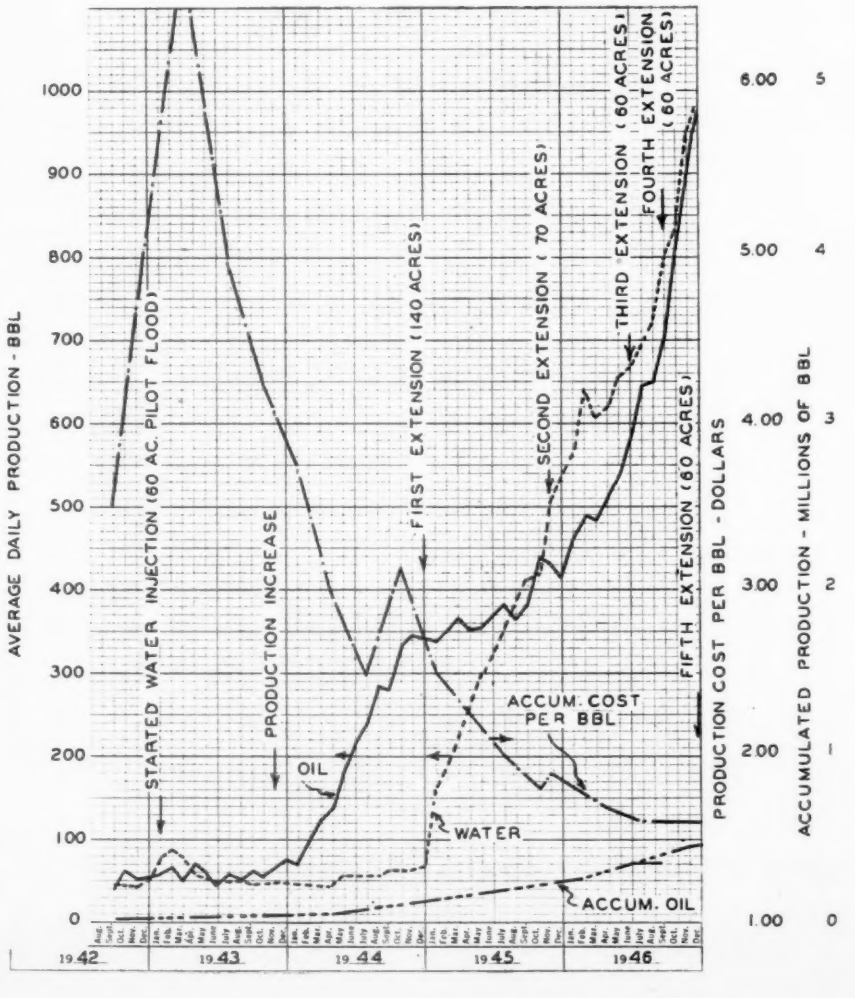
on a 20-acre spacing while injecting at about 3.5 bbl of water per foot of sand. Lease B is on a ten-acre spacing while injecting water at a higher rate and as much as 10 bbl of water or more per foot of sand. Although the three floods are not completed, the data do indicate that the wider spacing and slower rate of injection will obtain results with smaller volumes of water injected and thereby produce more oil per barrel of water injected.

Production history. The development of the pilot water flood on Lease A (Fig. 7) was started in October, 1942, and was developed relatively slowly in that 420 acres of the 540-acre unit was developed over a period of four years. The injection of water into the six pilot water flood input wells was started in January, 1943. The water was injected into six input wells at about 5 bbl of water per foot of permeable productive sand per day per well and was continued at this rate until December, 1943, at which time evidence of increased oil production was observed. In October, 1944, the production had increased from 52 bbl per day from 54 wells to about 350 bbl of oil per day, at which time the first extension, consisting of 140 acres completely surrounding the pilot water flood, was put into operation. Oil production continued to increase until October, 1945, to about 440 bbl per day, at which time the second extension, consisting of 70 acres along the south and west edge of the developed flood, was placed under operation. During, 1946, the third extension of 60 acres, the fourth extension of 60 acres, and the fifth extension of 50 acres was developed, and as of January 1, 1947, the daily production of oil was 990 bbl of oil per day, while the water-oil ratio of 1 to 1 is about the same as it was when pilot flood was started. At the present time, the lease is producing a little less than 1100 bbl of oil per day, and with subsequent extensions, which are in the process of being made, production of oil should reach 1800 to 2000 bbl per day in about six months.

It is of interest to observe that Lease B (Fig. 8), which is comparable to Lease A, was put under flood about the same time. The Lease B flood was developed at a faster rate, in that a total of 395 acres was developed in less than 18 months, and the daily production of oil and water, after attaining the initial increase in oil production in about six months after starting the water injection, increased rapidly and reached a peak of approximately 2400 bbl of oil per day, while producing a water-oil

FIG. 7. Development of pilot water flood on Lease A.



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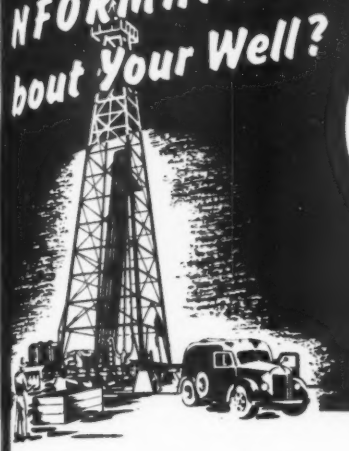

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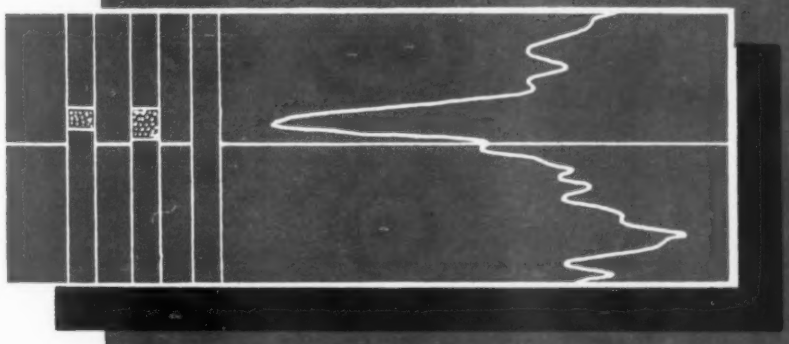

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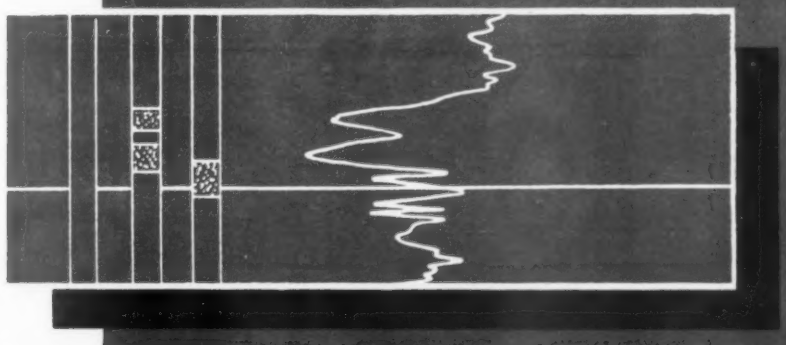

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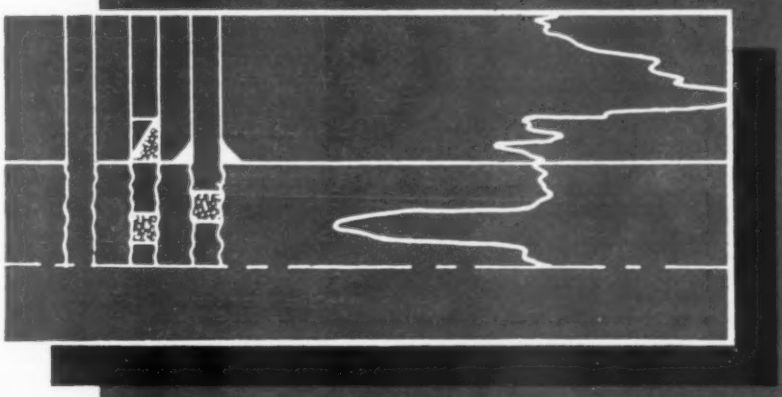

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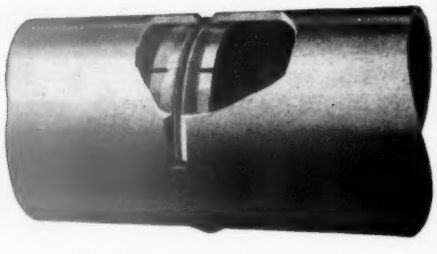

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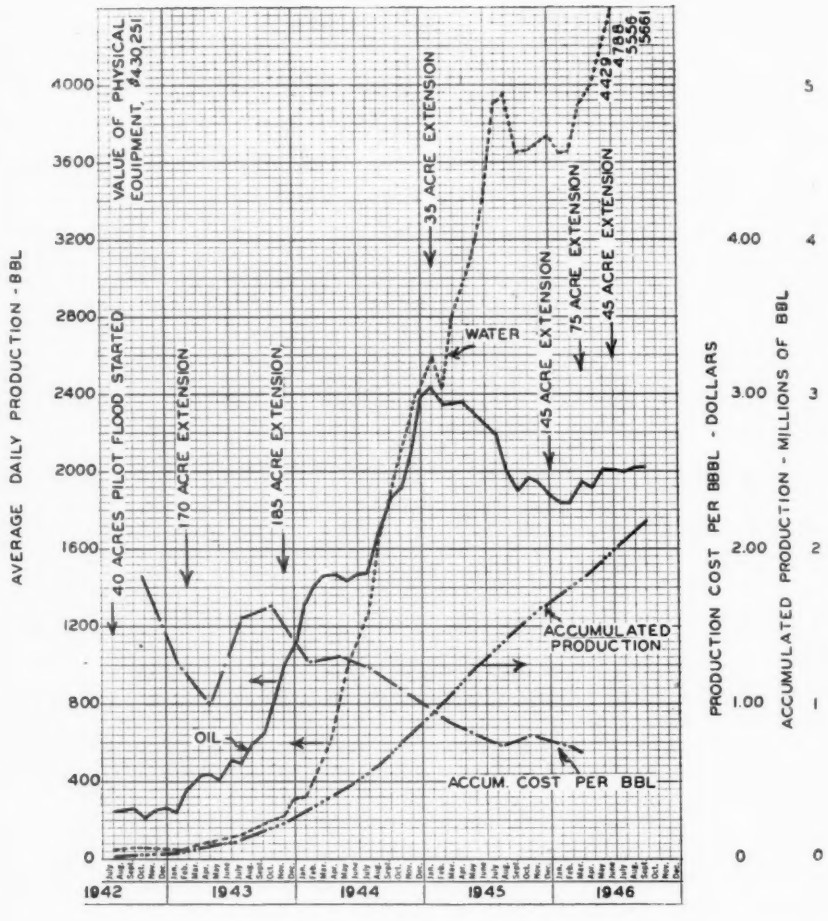

FIG. 8. Lease B flood development.

ratio of 3 to 1. Comparing the operation of these two leases, it is evident that a rapid development of a project is possible, and the payout of the operating expense and development cost would occur in a shorter period of time. Lease B, along with being developed rapidly, used a relatively high rate of water injection initially (10 bbl per permeable productive foot of sand per day per well), which also effected the rate of increase of oil production.

Also for comparison, with the exceptions of the well spacing and the rate of injecting water, Lease C (Fig. 9) is comparable to Lease A and Lease B. Lease C is developed on a 20-acre spacing and utilized an injection rate of about 3½ bbl of water per foot of permeable productive sand per day per well. Fig. 9 indicates that water was injected for about two years before evidence of increased oil production was observed, and there has been no increase in water production.

The use of wider spacing and slower rates of injection of water on Lease C has resulted in slower response to water flooding and the rate the oil production increases is slower than in the case of Lease A or B. Also, it is noted that the Lease B, while being flooded at a high rate of injection, has increased in water production faster than either Lease A or C.

Costs. The water input well spacing pattern for Lease A was on a ten-acre spacing. All water input wells were drilled and with the exception of one well, the oil-producing wells were old wells that were drilled originally on the lease. The development cost for the project, as of January 1, 1946, has been about $1450 per acre. Production cost per barrel of oil, as of the same date, has been about 40 cents per bbl. In Fig. 7, the cumulative total cost per barrel for Lease A is indicated, and at the present time it is about $1.60 per bbl. It is significant to note that the lease has produced only about 500,000 bbl of oil, as of January 1, 1947, and it is estimated that it should produce 2,700,000 bbl. Therefore, the project should produce an additional 2,000,000 bbl of oil during the next five or six years, resulting in relative low overall production and development cost per barrel of oil. In Fig. 8, production data and the cumulative total cost per barrel are shown for Lease B. The development cost per acre on Lease B is comparable to Lease A and at the present time, under the higher rate of development of project and injection of water, the overall cost is about 70 cents per bbl. In Fig. 9, the cumulative cost per barrel is indicated for Lease C and is much higher in that the total oil production is low because the flood has not been operating long

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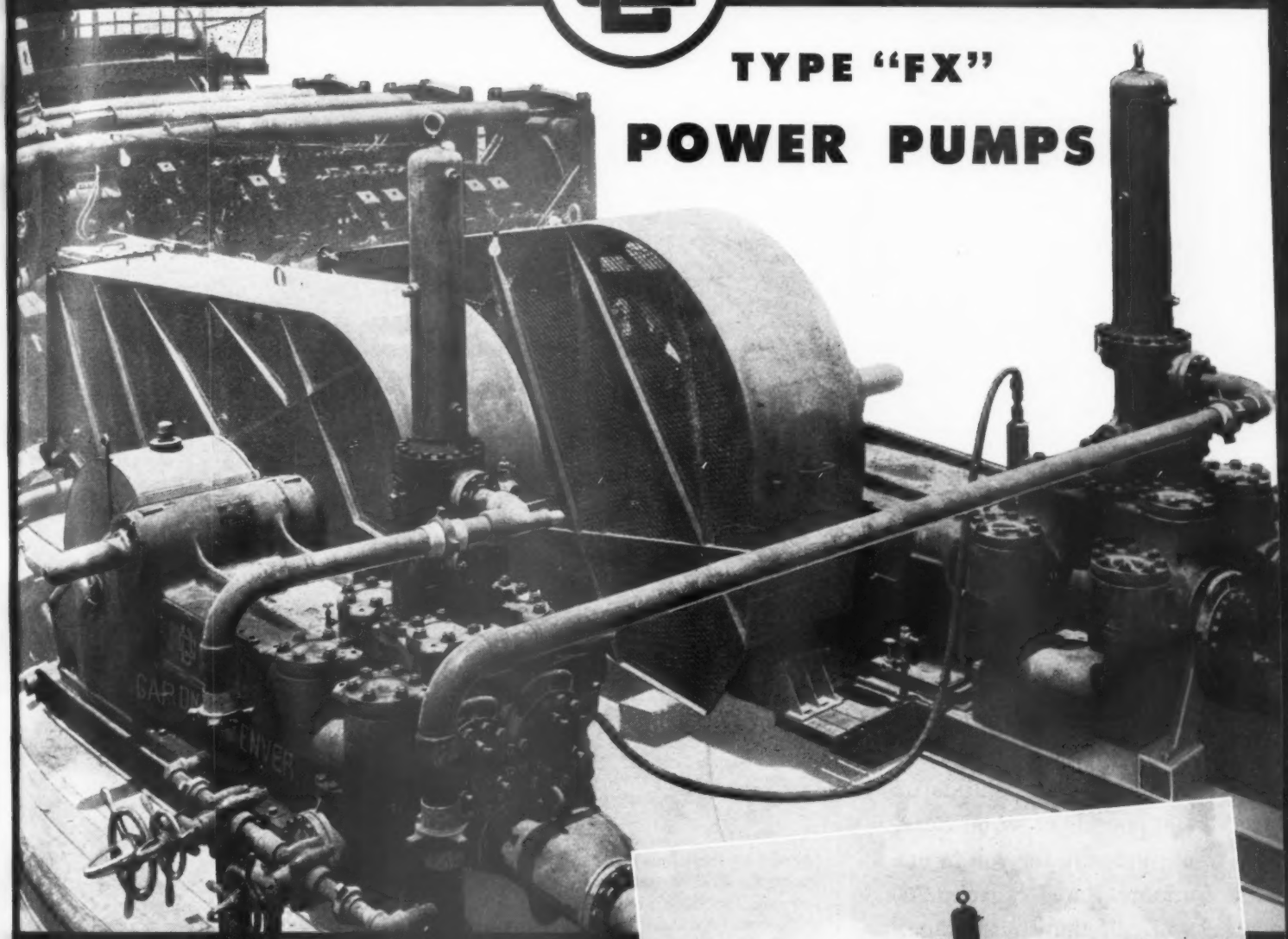

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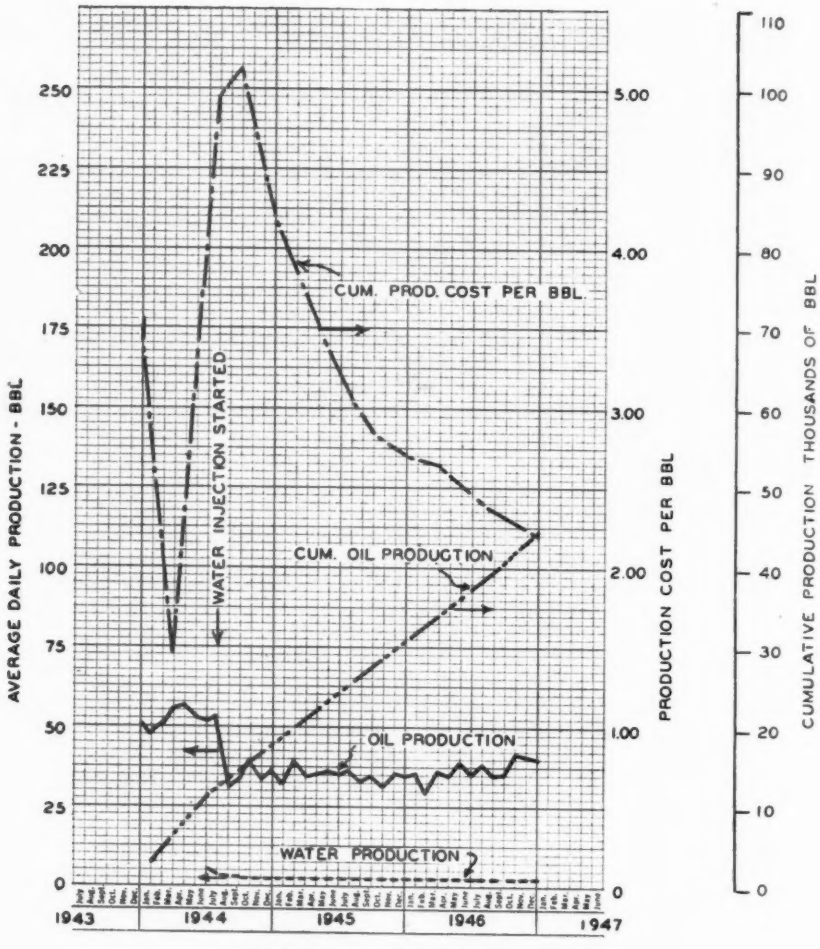

FIG. 9. Lease C flood development.

enough to obtain major results from the water flood. The development cost for Lease C has been about $400 per acre, as the result of using a wider well spacing and some of the old oil wells for water input wells. The production cost per barrel on Lease C likewise is relatively high at this time; however, it is apparent that such costs will be reduced rapidly when the oil production is increased by the flood.

● **Conclusion.** Although the four floods discussed are still being developed, the results at this time indicate that they will be successful from the standpoint of economically increasing the ultimate recovery of oil.

The results of these floods should not be accepted enthusiastically to the extent that they will influence operators to install water flood programs on their individual leases without first having a competent study made to predict what may be accomplished in their reservoirs by water flooding. This is important because some reservoirs do not have suitable characteristics that are adaptable to successful water flooding.

To successfully water flood North Texas reservoirs economically, it will be necessary to develop programs on a sound engineering as well as a practical basis that will satisfy both the reservoirs and economic conditions peculiar to the local fields.

The early shallow water floods were developed on a closely spaced well pattern. Experience, so far, in North Texas indicates that the producing sands can be flooded successfully with a wider well spacing pattern than was normally used in other areas. The wider spacing pattern will result in a lower development cost per acre, which is necessary in North Texas for profitable operation, in view of the thinner sands and lower oil recovery per acre.

Water flooding operations in North Texas will require close cooperation between offset operators that are involved in a cooperative water flood program. It might be necessary, to gain the most economical and profitable operation, to have all leases included in the water flood area completely unitized.

● **Acknowledgments.** The study of water flooding operations, the results of which are the basis for this report, have been carried on for a number of years by the Magnolia Petroleum Company on their own, as well as on properties being operated under unit agreements. The valuable assistance given by the field personnel is gratefully acknowledged. Acknowledgment is due all members of the units under which the work was done and for the permission to discuss and publish the information that was acquired while operating the respective water floods. ★ ★ ★

Modern fluid catalytic cracking

By **E. VAN DORNICK,** *Industrial Consulting Engineer*

EXCLUSIVE

OPERATION of the numerous fluid catalytic cracking units for the production of motor gasoline has proved this type of unit to be satisfactory in meeting the refiner's requirements of flexibility, dependability, and economy.

The urgencies of war have resulted in an accumulation of experience and data, in this relatively new technique, adequate to permit an evaluation of their operation in order to incorporate improvements supplementing the best design features of the existing units.

Return to the normal conditions of competition requires that the customary emphasis be given to modifications and improvements in the design in order to result in the desired processing requirements at the minimum cost. Minimum cost is interpreted to mean the maximum earning power of a unit during the period of its usefulness as a result of its ability to meet changing market requirements on a variety of feed stocks and to produce therefrom the optimum yield of the desired products.

Minimum cost therefore must include consideration of (1) product quality and yield, (2) operating and maintenance expenses, (3) on stream time, (4) obsolescence, and (5) initial cost. The preferred condition is the attainment of all the elements of the minimum cost in addition to the lowest initial cost.

Experience with the existing units indicates that in order to achieve minimum cost and maximum earning power, the following operating features are essential:

1. Flexibility
2. Gas oil recycle
3. Low catalyst-to-oil ratio
4. Efficient catalyst recovery
5. Effective spent catalyst stripping
6. Feed preheating and catalyst cooling.

● **Flexibility.** Inasmuch as market requirements, product specifications, crude sources, and refinery balances change appreciably throughout the life of a processing unit, it is essential that the unit be able to adapt itself to such changing conditions without sacrifice of yield, quality, or throughput.

Such adaptability requires that the unit be able to process charge stocks ranging from light gas oils to reduced crudes at the optimum cracking conditions.

Optimum cracking conditions are achieved as the result of the ability to adjust the catalyst holdup, temperature recycle rate, and catalyst rate at the specific values required for the particular charge stock being processed. The reactor of a fluid unit is inherently a completely flexible instrument wherein the catalyst bed depth can be adjusted at will to give any desired catalyst holdup, the temperature can be varied from that required to vaporize the feed to over 1000 F, the catalyst-to-oil ratio can be varied as desired over wide limits, and the combined feed proportions of fresh feed and recycle can be varied over the full range of 0 to 100 per cent recycle. Such wide limits of variability insures the optimum cracking conditions at all times.

The regenerator likewise has complete flexibility up to the limit of its carbon burning capacity. As it is desirable to maintain the catalyst-to-oil ratio at a reasonable minimum the regeneration temperature is preferably held as high as is consistent with good catalyst life and mechanical limitations of equipment at the elevated temperatures—1075 to 1100 F is considered a reasonable regenerator temperature.

For the rare cases of inadequate carbon deposition in the reactor and inadequate feed preheat to supply the heat requirements of the unit, fuel oil may be injected into the regenerator to supply the heat deficiency. For most operating conditions wherein the carbon deposit is adequate or in excess of the units heat requirements, such excess heat may be removed by catalyst coolers and lowering the feed preheat temperature.

The regenerator is unaffected by the slight changes in catalyst holdup resulting from changes in the reactor bed depth, catalyst losses, and makeup or catalyst-to-oil ratios.

The reactor and regenerator therefore are completely flexible and can retain this flexibility when operating in conjunction with each other provided that feed preheating and catalyst cooling are utilized to keep their heat balances relatively independent.

● **Gas oil recycle.** Gas oil recycle should be utilized when it is desired to produce the maximum economic yield of gasoline from a limited quantity of fresh feed.

Where fresh feed is not a limiting factor, a single pass operation at optimum cracking conditions of about 50 per cent conversion results in the lowest cost unit for a given product yield.

The maximum economic yield of gasoline occurs at about 70 to 75 per cent conversion of the fresh feed; however, if such a conversion were accomplished in a single pass it would result in high carbon and gas yields with a correspondingly low liquid recovery. It is therefore advisable to limit the conversion to 50 per cent per pass and to recycle gas oil to the extent of 30 to 50 per cent of the fresh feed in order to obtain the desired ultimate conversion.

Although the use of recycle is of major importance in obtaining the maximum economic yield of gasoline, it has the further advantage of achieving a well balanced unit from a capacity-flexibility standpoint. If a high conversion single pass or insufficient recycle operation were employed they would result in a disproportionately large regenerator and a small reactor and fractionator. This is undesirable, due to the relatively high cost of the regenerator and inability to utilize its full capacity on other operations because of the limiting capacity of the reactor and fractionator. So, too, unduly high recycle is to be avoided in limiting the carbon production because this will result in an undersized regenerator compared to the overall cost of the unit. For approximation purposes a good flexibility capacity balance of the regenerator, reactor, and fractionator capacity against the cost of be about 1000 lb per hr coke production (coke is 90 per cent carbon and 10 per cent H.) per 1000 bbl per day fresh feed and 35 per cent recycle. For a specific unit, operating conditions should be selected by evaluating conversion, recycle rate, coke production, and reactor-fractionator capacity against the cost of the unit and yield of product.

● **Low catalyst-to-oil ratio.** Low catalyst-to-oil ratio should be utilized insofar as it is possible to reduce the operating costs thereby. The catalyst-to-oil ratio should be evaluated in terms of its catalytic effect and utility as a heat transfer medium versus its contribution to catalyst loss resulting from attrition and deactivation and increased coke. Although all the factors involved in variations of the catalyst circulating rate have not yet been precisely established, the general trend is evident as favoring low rather than high catalyst-to-oil-ratios.

The minimum catalyst-to-oil ratio permissable to obtain the desired catalytic effect is well below the ratio justified by its utility as a heat carrier. As a heat carrier it is well suited to supply the heat requirements at the higher temperature levels where coking would be ex-

perienced with conventional means of heating but its indiscriminate use for heating purposes much below 675 F is questionable.

The most significant disadvantage of high circulating rate is the increased coke production resulting therefrom. This is due to the entrainment and adsorption of hydrocarbon vapors by the spent catalyst and which is incompletely removed by the stripper. Improved stripper design has resulted in an appreciable reduction of the coke from this source; however, decreasing the catalyst circulating rate is the most positive means of reducing this type of coke production.

Catalyst-to-oil ratios ranging between 5 to 1 minimum and 10 to 1 maximum are considered to be satisfactory, with the minimum ratio being preferred.

High catalyst circulating rates result in increased attrition of the catalyst and the production of fines that are ultimately lost from the system; further, the repetitive contacts of catalyst and steam causes deactivation of the catalyst and therefore reduction in the circulating rate will tend to reduce both of these losses.

Another apparent factor in carbon production is the temperature differential between the hot catalyst and feed stock at the point of mixing. In transferring most of the feed preheat by means of the hot catalyst, the film of hydrocarbon initially enveloping the hot catalyst particles is subjected to severe cracking conditions for a longer period of time than would be the case with a preheated feed.

● **Efficient catalyst recovery.** Efficient catalyst recovery from the regenerator flue gas and fractionating section is essential in order to keep the replacement of catalyst losses from becoming the largest item of operating expenses. If synthetic catalyst is used a recovery of better than 99 per cent of the fines in the flue gas to the Cottrell is readily demonstrated to be justifiable economically.

A certain amount of catalyst loss is not undesirable in order to permit replacement for maintenance of the desired catalyst activity level, but any loss beyond this point is needless waste. The recovery of catalyst fines is advisable for the further reason that the smooth flow of catalyst for surge free operation requires a certain percentage of fines in the circulating system.

Although a certain amount of catalyst reactivation is inevitable due to impurities in the feed and continuous operation at high temperature, those contributing factors that can be controlled, of which stripping steam is one, should be held to a minimum by maintaining the lowest catalyst circulating rate.

● **Effective spent catalyst stripping.** Both in initial cost and operating cost the regenerator is the most expensive single item of equipment and therefore every means should be used to confine its function to the burning of unavoidable carbon.

Provided cracking conditions are optimum, the major source of avoidable carbon and hydrogen is due to incomplete stripping of the entrained and adsorbed hydrocarbons from the spent catalyst. Such incomplete stripping may increase the regenerator duty by as much as 15 per cent, which represents increased operating cost and decreased yields, neither of which are desirable.

The solution to this problem is to: (a) Reduce the stripping duty to a minimum by means of a low catalyst circulating rate; (b) utilize the most efficient cellular stripper design, and (c) use the maximum amount of stripping steam permissible at the lower rates of circulation. Due to the fewer steam-catalyst contacts deactivation will not be increased because of the higher steam rates.

Research on improved anti-knock gasolines offers about 50 per cent more mileage and reduced motor-fuel bills. These new gasolines can be made to operate in future cars, which will have engines of a higher compression ratio than present models. Automotive experts believe these future cars can be built at the cost of present-day models.

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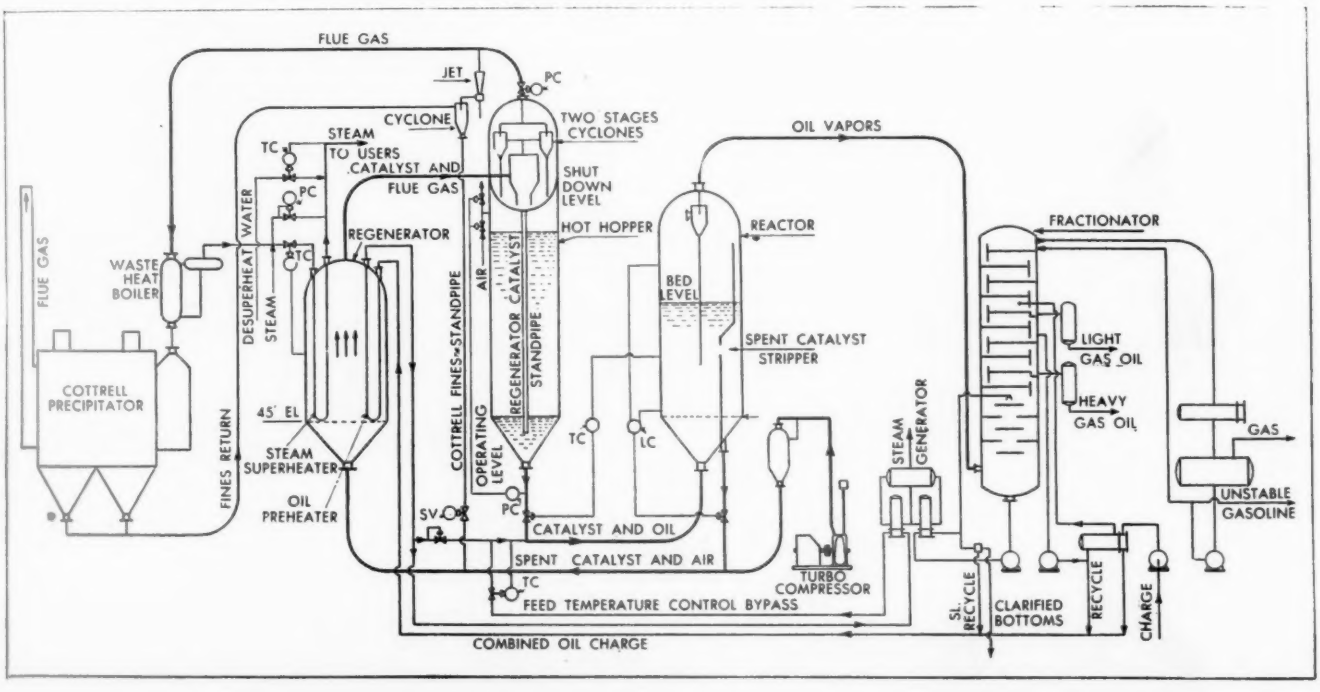
● **Feed preheating and catalyst cooling.** Feed preheating and catalyst cooling are primarily important in their contribution to the flexibility of the unit by maintaining the heat balances of the regenerator and reactor independent of each other.

If they are included it is then possible to select the optimum reactor conditions of catalyst holdup, temperature, catalyst-to-oil ratio, and recycle rate for the specific feed stock being processed without particular regard for their effect on the regenerator. It is of course uneconomical and unnecessary to preheat the feed externally to the reactor temperature, or to provide catalyst cooling facilities for the entire heat of regeneration. A feed preheat in the neighborhood of 700 F with the corresponding catalyst cooling appears to be adequate for full flexibility requirements.

Although it is entirely possible to design and operate this type of unit over wide limits in what is called a heat-bal-

Low cost fluid catalytic cracking unit.



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ance operation wherein the heat requirements of the reactor are adjusted to conform to the heat of regeneration, such operation is achieved only at the cost of a high catalyst-to-oil ratio with its attendant disadvantages of increased catalyst loss due to attrition, and deactivation and lack of full flexibility.

● **The low-cost unit.** A variety of arrangements of equipment were investigated with the object of incorporating all elements previously outlined in addition to retaining the preferred features of the conventional type unit in order to achieve the best design at the lowest cost.

Furthermore, it was felt desirable to insure the feasibility of the proposed design by using only those elements known to be satisfactory through extended commercial operation thus minimizing any questionable innovations even though they have been confirmed to a limited extent by pilot plant operation.

The final design arrived at, which is illustrated herewith, utilizes an upflow type of regenerator and a bottom draw-off type reactor, both of which have been proved commercially to have the necessary requirements for completely satisfactory operation.

In the case of the regenerator, the essential design features are:

1. Ability to reduce carbon content of the catalyst to a low residual level.
2. Utilization of the regeneration air to a low residual oxygen content.
3. Absolute control of regeneration temperature.

For each of the above, the upflow regenerator has proved itself to be entirely adequate.

In the case of the reactor, the essential features of the design are:

1. Selective control of the catalyst bed depth.
2. Absolute control of the reactor bed temperature.
3. Effective stripping of the spent catalyst.
4. Operation at the preferred conversion.

In each of the above, the bottom draw-off reactor has proved itself to be superior.

For the integrated unit in addition to the features previously discussed the following are also desirable:

1. The use of only rugged items of equipment.
2. An independent-interrelated functioning of the regenerator and reactor.
3. Inherent ability to absorb wide fluctuations with no upset in the continuity of the operating conditions.
4. Ease of control.

The proposed type of unit accomplishes the above objectives for the regenerator, the reactor, and the integrated unit.

Operating experience has proved the desirability and utility of a storage hopper that is suitable for receiving hot catalyst directly from the system in order to facilitate both normal and emergency shutdowns. In the proposed arrangement the hot hopper is used as an integral part of the circulating catalyst system whereby the catalyst flows from the regenerator through the recovery system and into the hot hopper and is withdrawn from this vessel for charge to the reactor. This arrangement reduces shutdown procedure and disposal of catalyst from the regenerator and reactor to merely closing the regenerated catalyst slide valve at the bottom of the hot hopper thereby accumulating the catalyst in the hot hopper. The hot hopper also absorbs all the fluctuations in catalyst flow, catalyst losses, and makeup.

For the conventional type of unit, a low catalyst-to-oil ratio is obtained by preheating the feed with heat exchange and a direct-fired heater. This effectively reduces the catalyst circulation but inasmuch as the heat of regeneration remains constant it then becomes necessary to use catalyst coolers in order to remove this excess heat of regeneration. In the proposed arrangement it is intended to accomplish this objective by only one transfer of heat to a coil within the regenerator. This coil is essentially identical to a fired heater coil, having conventional headers on the upper ends of the tubes outside the regenerator The tubes extend vertically downward to the lower portion of the regenerator and have long radius welded return bands at the lower ends.

This coil will operate to preheat the charge stock and remove the heat of regeneration. In so doing it achieves the minimum catalyst-to-oil ratio with only a single transfer of heat. Regenerator temperature control is accomplished by means of a steam superheating coil, of the same construction, which is used to superheat all steam generated within the unit. A desuperheating nozzle is placed in the outlet of this coil in order to maintain a constant superheat temperature of the steam to the operating equipment. If it is desired an inert circulating medium such as salt can be used in place of oil in the coil and this in turn used to preheat the oil charge in shell-and-tube equipment.

The use of an upflow regenerator incorporating a heat removal coil within the vessel itself permits the location of this large item of equipment essentially at grade. The necessary head required on the regenerated catalyst to cause the desired flow is accomplished by placing the catalyst-flue gas cyclones in the top of the hot hopper and extending the regenerated catalyst standpipe vertically downward to near the bottom of the hot-hopper. A pressure controller maintains the desired upstream pressure on the slide valve by regulation of the air pressure in the hot hopper and this pressure is in turn balanced by catalyst buildup in the standpipe plus the back-pressure on the regeneration system. As the catalyst accumulates in the hot hopper the air pressure therein is automatically decreased to maintain a constant pressure on the slide valve.

The Cottrell precipitator is also situated at a low elevation. The return of fines to the system is effected by means of a cyclone and jet arrangement operating as a pneumatic conveying system to carry the fines to the elevation required to give the standpipe pressure necessary to return the catalyst to the spent catalyst riser. The jet exhausts into the flue gas sysem for return to the Cottrell.

The net result of the above proposed modifications is a reduction of 15 to 20 per cent in the initial cost and an appreciable reduction in the operating costs compared to a conventional unit designed for a 5 to 1 catalyst-to-oil ratio.

● **Description of the operation.** Oil charge to the unit is preheated to 750 F by heat exchange in the fractionating section and the oil coil in the regenerator. The preheat temperature is maintained constant by a temperature controlled bypass of a portion of the oil to a steam generating unit in the slurry system. The combined charge is mingled with catalyst from the hot hopper and the resulting oil-vapor catalyst mixture conducted into the reactor where the reduced velocity permits settling of the catalyst into a dense bed. The bed depth is controlled as desired to obtain the required conversion.

The oil vapor velocity in the reactor is sufficiently low to permit essentially complete settling of the catalyst and the small amount carried to the fractionating section is recovered and returned to the system.

Spent catalyst from the reactor is withdrawn through a steam stripping section for removal of entrained and adsorbed hydrocarbons. The rate of withdrawal is regulated by a level controller set to maintain the desired bed depth in the reactor and controls the spent catalyst slide valve.

Spent catalyst is carried by regeneration air into the bottom of an upflow regenerator wherein the necessary burning of the carbon is effected. Heat removal from the regenerator is by means of direct contact of the catalyst with the oil and steam coils. These coils consist of 40-ft 4-in. ID tubes with $\frac{3}{8}$-in. walls placed circumferentially and extending downward into the vessel. The catalyst-air mixture is carried vertically upward through the vessel and removed from the top for separation of the catalyst and flue gas.

Control of the regenerator temperature is obtained by varying the heat removal of the steam superheater coil in accordance with the requirements of the temperature controller maintaining the regenerator bed temperature. This temperature controller operates in conjunction with a pressure controller in such manner that the quantity of steam not

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In a sense, work on synthetic rubber began in 1826 when Faraday found that lastex is a hydrocarbon, says Boss "Ket." It was not until 1860 that isoprene was isolated from rubber, and not until World War I that the first products of so-called synthetic rubber appeared.

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passed through the coil is bypassed and the total mixture of superheated and saturated steam is commingled at the outlet of the coil. A condensate injection nozzle is placed at this point to maintain a constant superheat temperature.

The steam temperature from the coil is thus permitted to vary as required to change effectively the heat removal by the coil. The coil is a multipass unit and will remove a fixed amount of heat depending on the coil surface used. The number of passes used may be varied as required to insure adequate heat to the steam coil for proper control.

The catalyst flue gas effluent from the regenerator is conducted into a two-stage cyclone separating system. The first stage consisting of a large single unit that removes approximately 95 per cent of the entrained catalyst. The second stage consists of a multiplicity of smaller units operating in parallel for removal of approximately 75 per cent of the remainder of entrained catalyst. The combined recoveries of the two stages results in a dust loading lower than that from a bottom drawoff regenerator with a single stage of cyclones. The flue gases pass through a pressure controller, waste heat boiler, to the Cottrell for final fines recovery.

Catalyst recovered in the cyclones is discharged through a standpipe into the bottom of the hot hopper, which during operation carries only a level sufficient to submerge the end of the standpipe. The pressure held at the flue gas exit plus the catalyst buildup in the standpipe automatically balances the pressure held in the hot hopper.

Regenerated catalyst is withdrawn from the hot hopper for mixing with the oil charge to complete the circuit. The rate of catalyst circulation is controlled by the reactor bed temperature controller, which regulates the regenerated catalyst slide valve.

1. Cost reduction:

(a) 40 per cent reduction in the diameter of the regenerator.
(b) Eliminates the direct-fired pipestill.
(c) Eliminates the catalyst coolers.
(d) Reduces the amount of large catalyst piping.
(e) Reduces the amount of foundations.
(f) Eliminates the separately fired steam superheater.
(g) Reduction in catalyst inventory by 115 tons.
(h) Reduction in catalyst line sizes by reducing catalyst-oil ratio.
(i) Reduces the amount of structural steelwork for support and access.
(j) Eliminates the catalyst cooler piping and slide valves.
(k) Eliminates most of the piping around the hot hopper.
(l) Reduction of piping in general.
(m) Eliminates the pneumatic handling system for fresh catalyst.

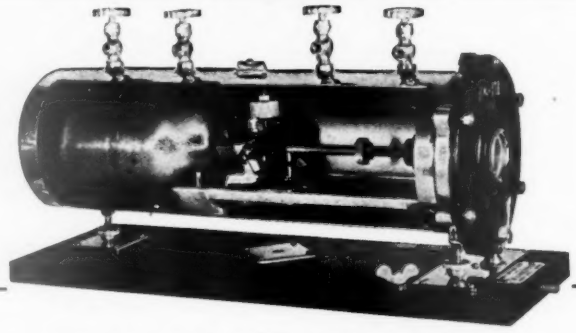
2. Process improvements:

(a) Reduces the catalyst-to-oil ratio to a reasonable minimum.
(b) Lower catalyst-oil reduces coke make and increases catalyst activity due to less steam stripping.
(c) Greater velocity in the regenerator gives more turbulence and better burning and heat distribution.
(d) Control of the differential across the slide valves gives better control of the unit.
(e) Greater catalyst recovery in the cyclones.

3. Operation and maintenance:

(a) Having the equipment at grade reduces the downtime for maintenance due to easy accessibility.
(b) The smaller regenerator has considerably less lining to be maintained.
(c) There is a considerable reduction in large catalyst piping.
(d) Eliminates the direct-fired heater maintenance.
(e) Eliminates the catalyst cooler maintenance.
(f) Reduction in slide valve erosion.
(g) Unit can be shut down and catalyst dumped in hot hopper in 1 hr.
(h) Startup can be accomplished with a minimum of manipulation.
(i) Elimination of the catalyst cooling system reduces maintenance.
(j) Carbon burning capacity can be appreciably increased by holding a higher back-pressure on the regenerator flue gas outlet.

★★★



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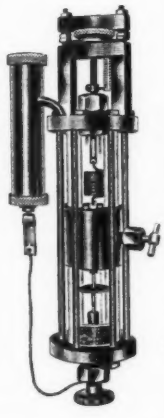

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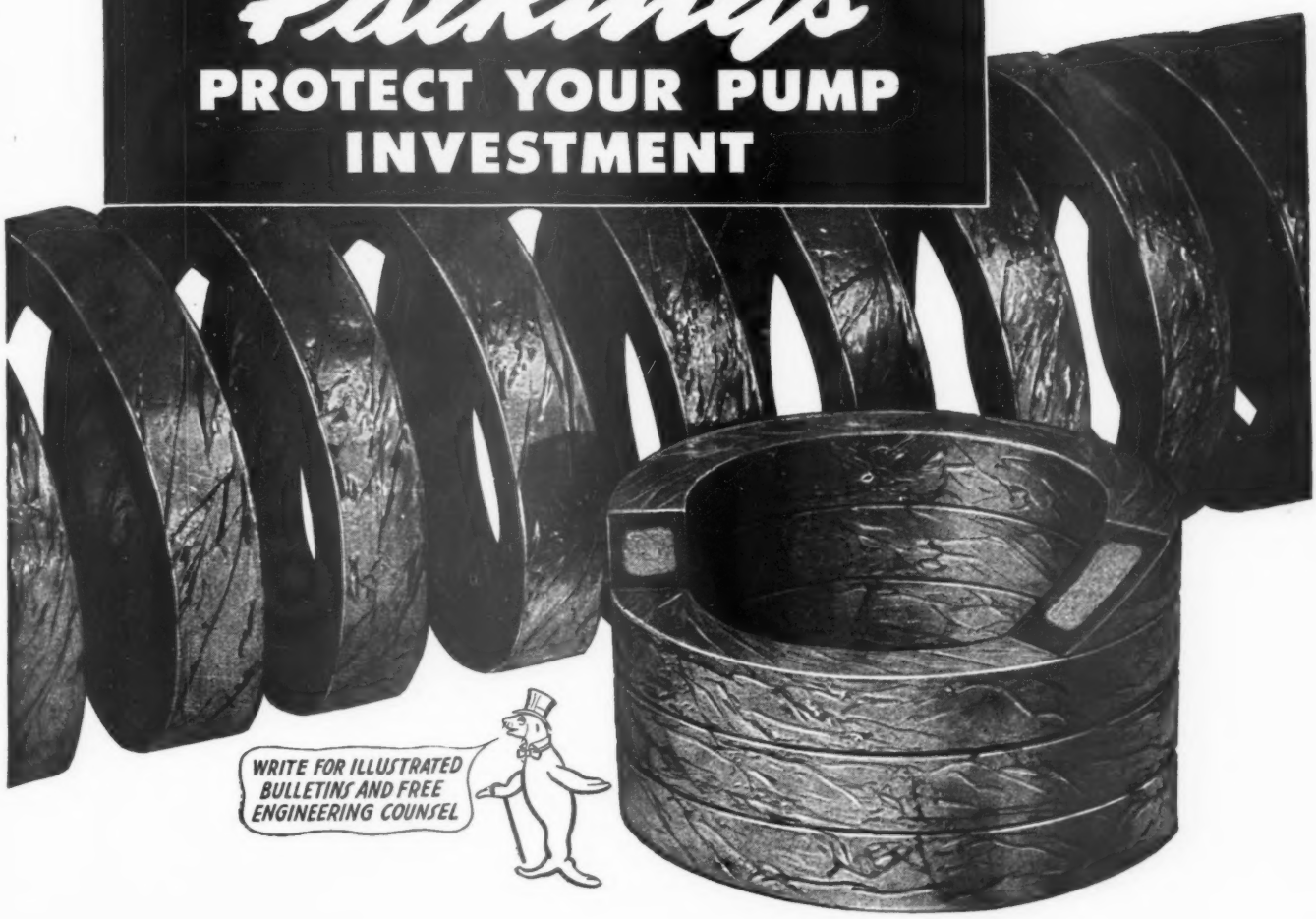

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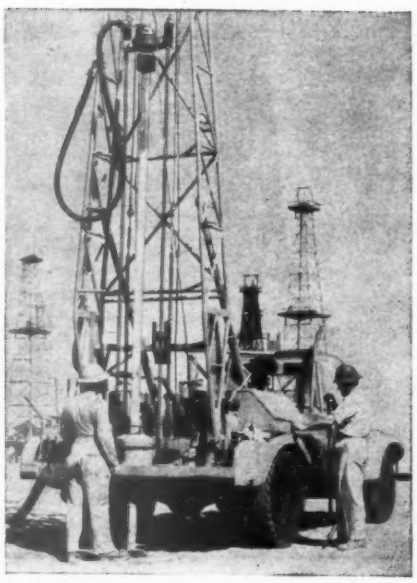
NEW EQUIPMENT

(1) Drilling unit

Western Geophysical Company, Los Angeles, California, announces production of a self-lubricated, completely sealed portable drilling unit. Of particular interest is the fact that no lubrication is ever necessary on any functional part of the unit with the exception of one zerk on the pull down shaft and one zerk for swivel packing. Successfully developed for their own use in exploration work, the Model 1000 is now available for drilling shot holes, shallow oil and gas wells, water wells, disposal wells, and other drilling operations.

The unit is mounted on a 1½-ton truck with a hydraulically raised 50,000-lb capacity tubular steel mast. All power is from the truck engine to a power take-off and then transmitted through a central power unit to a 3-speed rotary table transmission, a double-drum winch, and a 4½-in. by 6-in. Duplex pump and pull down unit. All parts are designed so that the engine will



stall before any part will break. Each functional part of the unit including swivel bearings features dust-proof sealed oil bath lubrication and requires no maintenance regardless of operating conditions. The rig is particularly recommended for hot, dusty, corrosive areas where lubrication may present a problem.

The Model 1000 is rated at 1000 ft with a 3-in. by 3-in. square kelly 14 ft long, handling 2⅜-in. drill pipe and 6½-in. bit. Holes up to 1500 ft have been drilled successfully with no strain on any part of the unit.

(2) Airco electrode

Airco No. 375 electrode for machinable welds on cast iron, a recent product of Airco research, has been announced by the Air Reduction Sales Company, 60 East 42nd Street. New York 17, New York.

This is an electrode with a high nickel core wire and a heavy extruded coating that has a possible application wherever an electrode is used on cast iron. Ordinarily preheating is not necessary.

Because of its high nickel content, Airco No. 375 flows exceedingly well and the resultant deposit is sound, it is stated. The weld and fusion zone is soft and easy to machine. Also, it will withstand hydrostatic pressure and may be used with ease in the downhand, vertical, or overhead positions. Multiple pass welds can be made without danger of cracking.

This new electrode may be used on either a.c. and d.c. and is available in 5/32 in. and ⅛ in. diameters. The manufacturer plans to add 3/32 in. and 3/16 in. diameters if the demand for them is large enough to warrant their addition.

(3) Fire equipment

An unlimited supply of extinguishing agent is provided as water fog with the new Underwriters' approved fire equipment in production by Bowser, Inc., Fort Wayne, Indiana, Fred S. Ehrman, Bowser general sales manager, announces. F. J. Lee is directing sales and distribution of the device through jobber sales outlets. It is known and identified in the line as their Figure 1030. The unit connects directly to a water line. A swing joint mounting makes it possible for the fixture to turn in alignment with direction of the hose pull. A 50-ft length of ¾-in. high pressure hose is racked in figure 8 position for fast removal without kinking.

Ehrman pointed out the unit is unusual because the nozzle supplies finely atomized water with medium pressures as normally provided by city water systems. Laboratory tests report a 20-ft fog projection at 50-psi nozzle pressure with a gallonage discharge of 15.9 per minute. At 75-lb nozzle pressure, the projection is increased to 25 ft with a discharge of 19.3 gpm.

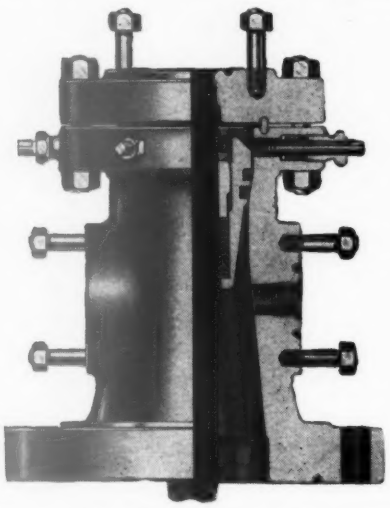
Recommended to be placed at points of great hazard, the fog nozzle produces a curtain of protecting fog in front of the operator, shielding him from the intense heat of the blaze.

Water fog has the ability to dilute vapors, washing the air so that it reduces the hazard of an operator being overcome by gas or smoke.

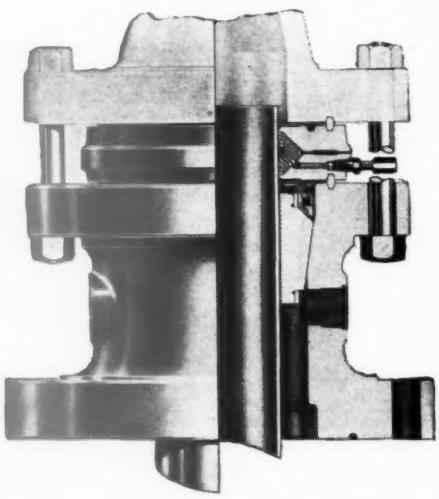
(4) Wellheads, flow wings

Cameron Iron Works of Houston, Texas, has announced a new casinghead, tubinghead, and flow wing for 4000 and 6000 psi test pressure service, each being of forged alloy steel construction.

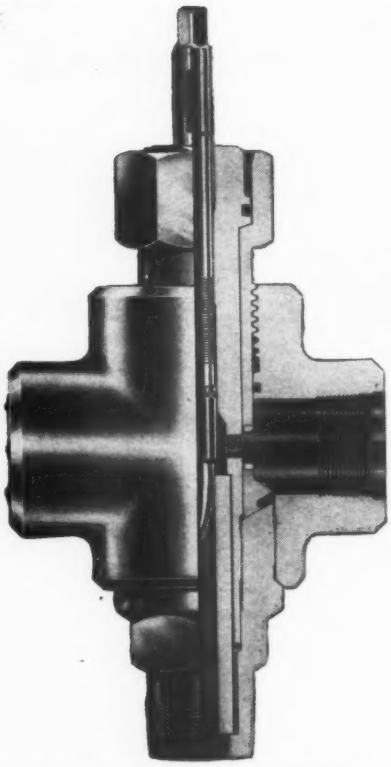
According to E. L. Lorehn, general manager of Cameron, these new forged steel products are the first complete wellhead units to come from the company's big 5000-ton forge press that was constructed at the close of the war on the suburban Houston site where the new Cameron manufacturing plant is now located. The forge press, which is one of the largest in the U. S, has been in operation for several months producing



Type "F" tubinghead with Type "FS" tubing hanger.



Type "F" casing spool with Type "YT" seal flange.



Type "F" flow wing with adjustable choke.

flanges, blowout preventer bonnets, fittings, and other parts.

The Cameron forgings provide close-grain steel, free of sand holes and other imperfections, and is heat-treated to produce high tensile strength, it is stated.

In the Type "F" casinghead and casing spools, Cameron presents a new series of wellhead equipment for low and intermediate pressure service.

An unusual feature of the Cameron Type "F" wellheads is the casing seal. The sealing means is provided in a separate flange assembly that fits between standard API flanges. As the flange studs are tightened, compressive force is transmitted through the flange assembly to the triangular shaped seal ring to force it into sealing engagement with the pipe.

The forged steel slips, in six segments, provide dependable suspension for the casing string. The segments are contained in a split cage so that they may be easily assembled around the casing.

The Cameron Type "F" tubinghead employs the lock screw design, which permits the tubing hanger assembly to be firmly locked and sealed on the tapered hanger seat by means of alloy steel set screws. Three types of tubing hangers are interchangeable in the Cameron Type "F" tubinghead, allowing the operator to select the type best suited for his particular well completion. The back-pressure valve allows the operator to safely wash-in the well under blowout preventer control. After the tree is installed the back-pressure valve is removed from the hanger by means of a Cameron valve removal tool.

The Cameron Type "F" flow wing for 3000-psi working pressure is the latest addition to the Cameron line. It provides in a single compact unit either an adjustable or positive flow bean plus a wing valve for choke changing.

The Cameron Type "F" flow wing may be readily converted from an adjustable choke to a positive choke type. This conversion may be accomplished in the field by simply substituting a plug for the adjustable choke stem and installing a flow bean of the desired size. It is available in studded body models or threaded.

(5) GM diesels

Of particular interest to operators and manufacturers of oil field equipment are the new and improved General Motors Series 71 "Twin 6" diesel engine models. Production of the new units has been announced by the Detroit Diesel Engine Division. These latest offerings of the well known "GM Twin Diesel" incorporate engineering improvements that promise to add considerably to their fine record of performance and adaptability to the many conditions peculiar to oil well installations

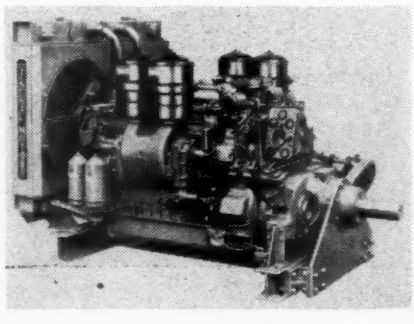
Each Twin unit is made up of two basic GM 6-cylinder 2-cycle engines that are geared to a single shaft. Units are offered with either right or left-hand rotation. Continuous bhp at 1800 rpm is 276 with a maximum rating of 400 at 2000 rpm.

Probably the most outstanding feature of the new models is in the variety of power take-off arrangements that are being made available. Versatility is the keynote. Any one of four different transfer gear types can be selected as follows:

1. The H.D. or heavy duty power take-off has been designed to take pulley and chain drive side thrust without the need for a special cradle-mounted sheave or sprocket.
2. The S.S. or stub shaft "fills the bill" with any of the various types of couplings encountered with compounds and other oil well machinery.
3. The D.F. or drive flange is available for installations where the driven machinery is to be coupled directly to the power unit.
4. The O.H. or S.A.E. "O" size housing has been designed to support any close coupled power take-off within the proper horsepower range. Particular attention has been given to its application with torque converters.

Gear ratios of 1:1 direct drive, and

GM Diesel Model 12103.



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GAS · OIL RATIOS OUT OF LINE?
WELL SANDING UP?

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THE MATERIAL THAT'S EASILY REMOVED*

WHEN YOU are confronted with any one of the many problems which necessitate remedial work, rely on SECURALOY for safety and economy. SECURALOY can be completely removed with a *drilling bit* or *chemicals* when desired, yet its physical properties are capable of withstanding the most rigid oilfield requirements. The use of SECURALOY casing sections, liners, tubing, tail pipe, packers, hangers, adapters, formation tester bodies, etc., enables farsighted operators to economically recomplete their wells, obtain longer producing life and greater returns from their oilfield investment.

By standardizing on SECURALOY drillable pipe and accessories, you can guard against many of the risks that cause expensive fishing jobs or premature abandonment.

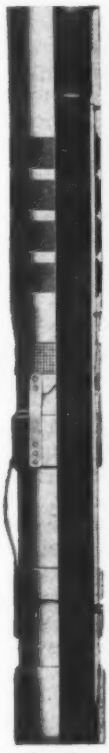
Over the past 10 years the outstanding success of SECURALOY has completely revolutionized long-established drilling and production methods. It has been used in thousands of wells representing an extremely wide variety of conditions. SECURALOY is constantly being used to solve problems arising from the development of new oilfield methods and techniques.

Probably the very SECURALOY installation you are wondering about for your well has already been successfully performed. At any rate it will pay you to consult our engineering department about the solution of your particular problem. SECURALOY assures your getting the most from your development dollar!

Security Drillable Pipe

Security Adapter

Security Bull Plug



Security Liner Hanger

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***SECURALOY CAN BE REMOVED WITH CHEMICALS, OR A DRILLING BIT**

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1.33:1, 1.77:1, and 2:1 reduction are available with each of the four power transfer gear assembly types. An increase in the shock load capacity over earlier models has been accomplished by the introduction of improved heavy duty transfer gears constructed with a 25 per cent increase in face width.

(6) Microhardness tester

The hardnes, not only of a piece of steel you may feel in your hand and examine with your naked eye, but of microscopic grains within the steel, can be measured by a new device designed at the Research Laboratory of United States Steel Corporation of Delaware. Still more minutely, the new microhardness tester can gage the hardness of a single steel grain at as many as three points within the breadth of a human hair.

By no means an instrument of abstract research alone, this tester is in continuous use at the Kearny, New Jersey, Laboratory, perfecting studies of the microscopic constituents of steel. The results of these studies are coordinated to develop steels of definite hardness and toughness for specific applications.

Like the Brinell, Rockwell, Vickers, and other traditional hardness testers, but on a much finer scale, the Kearny device operates by indenting the polished surface of a steel sample. Its diamond-point penetrator under a load of a very few grams leaves a square mark that can rarely be seen by the naked eye. The diagonals of this tiny square indentation are measured in microns, or thousandths of a millimeter, and this reading related to the load placed on the penetrator so that hardness may be computed.

Preparation of the sample of steel whose hardness is to be measured requires elaborate care. A small sample, which may be mounted in plastic, is ground and finished with polishing paper, care being exercised so the grinding effect does not extend below the surface. Then it is polished on wet lead laps.

The microhardness tester measures with amazing accuracy the hardness of the hardest steel constituents. This is necessary to know the degree of hardness of steel grains themselves, and of the iron and other alloy carbides. The mechanism consists of the indenter with a square-base, 136-deg diamond pyramid penetrator, the mechanical stage for holding the specimen, a microscope capable of magnifying the test field 500 to 1500 times, and a control box. All parts are assembled on a heavy cast-iron plate supported by steel legs that rest on insulated wooden blocks to minimize effects of vibrations present in the building. As many as 60 indentations may be made automatically at predetermined time intervals for surveying tiny gradients, which may have an important influence on the behavior of a fabricated product such as a weld.

(7) Tube aligning clamp

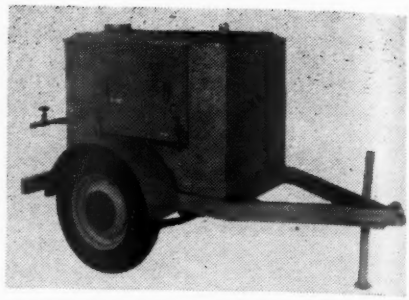
Thornhill-Craver Company, Houston, Texas, has announced a mechanical improvement for its streamlined return bends to provide a rigid support for the furnace tubes when the return bend body is removed for tube inspection. Heretofore, when the body was removed from the tube ends, the tubes could move out of alignment.

A split clamp (see illustration) fits around the upset tube ends and is held in position with a single bolt. Once installed, the clamp is never removed until it is necessary to replace the tubes. The clamp also serves as an anchor for the Unibolt holding members, thus eliminating the split ring that was formerly provided for this purpose.

(8) steam cleaning unit

The new, improved Oakite vapor steam cleaning unit, for use in cleaning and paint-stripping a wide variety of industrial equipment and plant facilities, is now available for immediate delivery, announces Oakite Products, Inc., of New York.

The unit, an enclosed-coil type, downdraft flame steam generator, delivers a hot vaporized spray in either wet or dry state under pressures up to 200 psi. The unit generates sufficient steam-cleaning pressure to operate two steam guns simultaneously. The improved model is said to incorporate simplified grouping of gauges and controls; redesigned piping system; plus a compressed-air valve accessory for two-minute anti-freezing of the entire water-steam system. The 12-gal capacity of the fuel tank provides ample steam generation for an uninterrupted 8-hr, two-gun cleaning cycle.



After the initial throttle setting, the unit operation is completely automatic. Patented, down-draft flame in a triple-insulated fire chamber provides rapid, economical steam generation (100 lb per min). A Standard dual-chamber steam gun is supplied with the unit. The cleaning solution is aspirated through the gun from a separate solution tank, by-passing the steam coils and totally eliminating coil-clogging by the cleaning compound, it is stated.

(9) Mobile spudder

An all-steel spudder that drills oil and gas wells top-to-bottom to 6000 ft and handles a wide range of servicing operations to 7000 ft—that is how Bucyrus-Erie Company, South Milwaukee, Wisconsin, describes the newest model in its line of mobile spudders. The new machine, known as the 48-L, has just been announced to the oil industry.

Bigger than any other spudder in the line, the 48-L retains the mobility characteristics that feature the smaller 36-L, 28-L, and 24-L machines, Bucyrus-Erie indicates. The new spudder is available as a semi-trailer or on skids for transporting on oil field trucks.

Up to 5000 lb of tools can be swung on the 60-ft derrick, an all-steel cantilever-braced telescoping box structure that is power-raised and extended by a built-in winch. Erecting the derrick requires only an hour, the manufacturer discloses. For handling exceptionally heavy casing loads, an extra casing tackle arrangement gives the 48-L derrick capacity for handling up to 120,000 lb static load.

A four-reel machine, the 48-L has spooling capacity of 12,000 ft of 7/8-in. drill line and 12,200 ft of 9/16-in. sand line without divider. The calf reel spools 1390 ft of 7/8-in. casing line and the calf reel storage drum spools an additional 1200 ft. The bull reel and sand reel are equipped with non-chafing dividers. Fast line speeds and powerful line pulls are performance features of the drums, which provide two forward speeds and one reverse on four reels. Accurate, positive braking is provided on all drums by friction brakes augmented by a hydromatic braking arrangement.

Automatic spooling of the drilling line is provided by the oscillating heel shaft and the spudding beam sheave, which is mounted on a swiveled bracket to prevent excessive offleads. Deflecting sheaves for the sand line and casing line

PITTSBURGH *Oil field* METER *and* SAMPLER

FOR *indisputable* RECORDS OF INDIVIDUAL WELL PRODUCTION

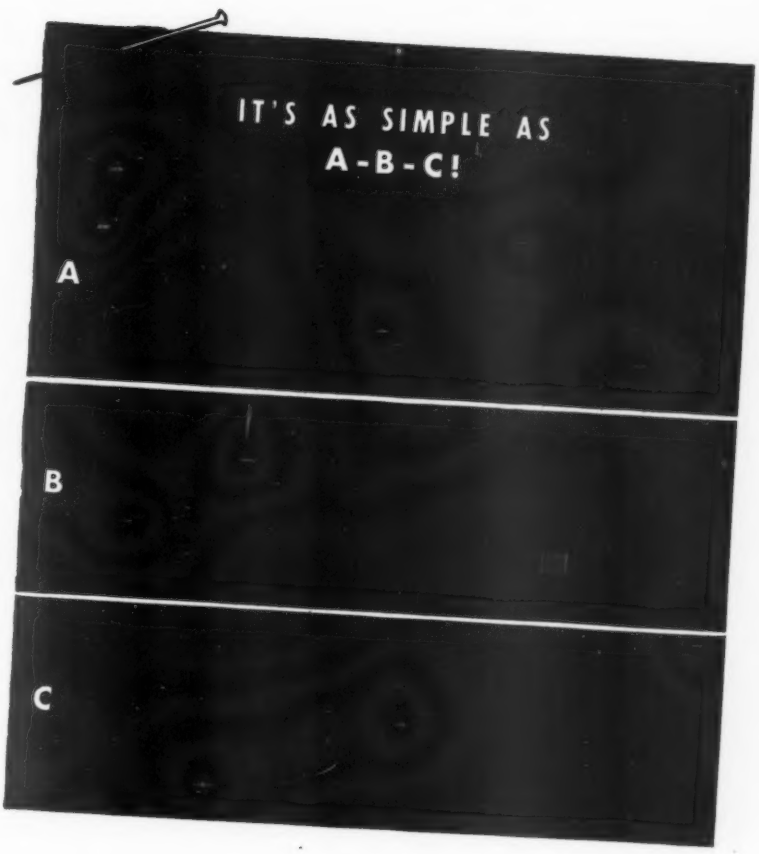
★ Here's an invaluable aid to oil producers. It sees all, tells all about individual well production. Simply install this unit on the line from the separator.

The Pittsburgh Piston Meter then accurately measures all liquid produced.

The Sampler, automatically and at predetermined intervals, takes a true composite sample of the metered mixture of oil and water. The percentage of oil produced is determined by direct reading from the graduated Sampler tube. This figure applied to the total meter reading establishes the true degree of well production. *Write for bulletin OG-350.*

Representative samples are taken from a rising stream, the only point where oil and water will mix in the same proportion as at the well head. The Sampler is actuated by the meter to almost instantly "grab" a small sample of liquid. The amount of each "grab" and the periodic intervals can be field adjusted to suit conditions.

Portable Well Testing Unit used for spot checking in field consists of Pittsburgh Meter and Sampler, Emco Orifice Meter, Emco Regulator, Liquid Level Valve, Separator, Nordstrom Valves and the necessary piping compactly assembled on a dolly. *Not furnished complete* but assembly drawings will be supplied to facilitate construction of this portable unit by the operator.



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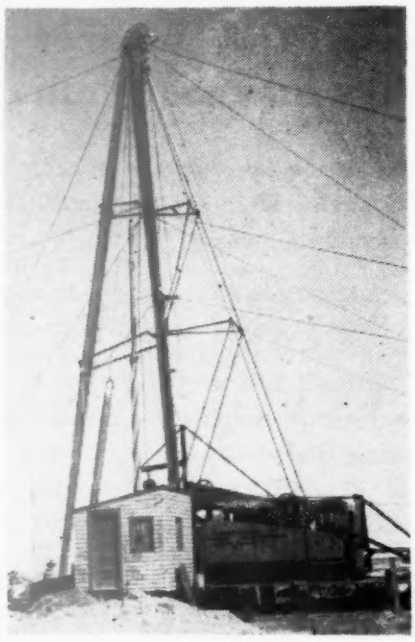
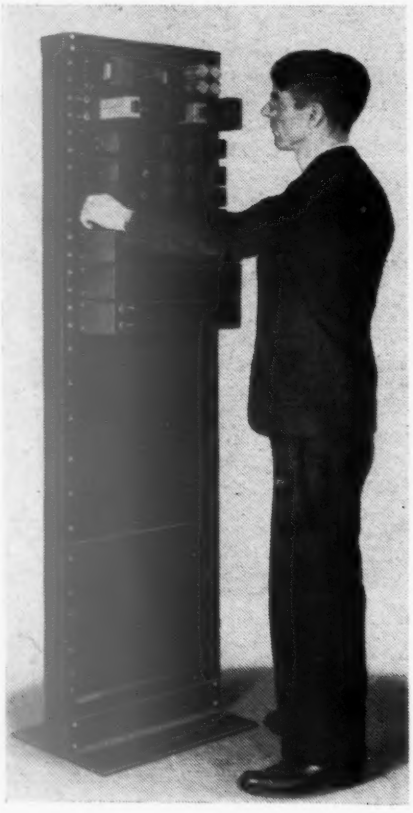
make spooling of these lines automatic also.

Operation of the machine is controlled from the drilling end of the machine, where all levers are conveniently grouped.



(10) Telephone carrier systems

Lynch Carrier Systems offer a simple and economical means of expanding the capacity of an open copper wire telephone line. According to the manufacturer, F. W. Lynch Company, San Francisco, California, the use of its equipment permits the addition of three telephone circuits to a line pair without impairment to the existing voice circuit.



The carrier units, standard rack-mounted, may be installed to add one, two, or three channels as the need for additional circuits arises. The second channel may be added to present single channel systems.

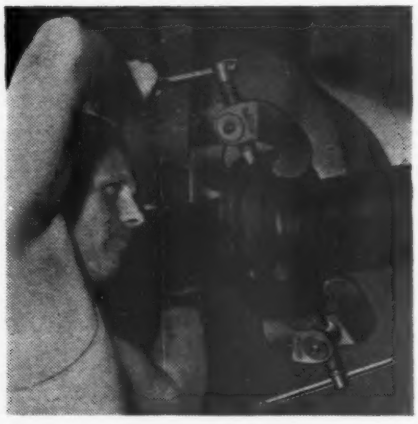
It is said that at today's construction cost, 250 miles of new copper line (one pair) would cost $50,000; however, by using Lynch equipment, the cost of doubling the capacity of an existing line would be $2400. This represents a saving of $47,600.

Lynch-Repeaters are available to extend ranges of operation to 1000 miles or more. Automatic gain regulation for long haul service is available. Signalling is optional on a ring-down or dial basis.

(11) Flange-jacks

The J. H. Williams and Company line of quality drop-forged tools has been broadened by the addition of the flange-jack as a stock item. These fully-patented tools were formerly manufactured by T. G. Persson Company of Bloomfield, New Jersey, and have already gained wide acceptance wherever pipe maintenance is a problem.

Used in pairs, the Williams flange-jack is the only tool that takes the guesswork out of replacing gaskets, regardless of line pressure or location. Flanges are parted quickly and held in perfect alignment without damage to faces. Shock and jarring of pipe lines, danger from flying



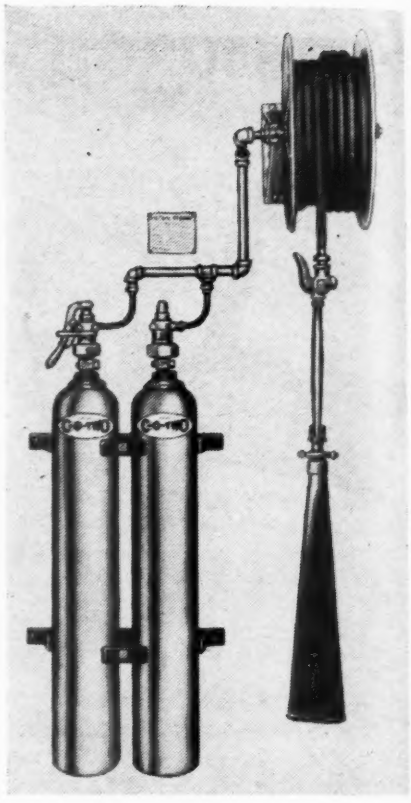
wedges and sparks caused by hammer blows are all eliminated.

Flange-jacks eliminate costly shutdowns by making possible fast, economical repairs in hard-to-get-at locations. Sold in pairs by Industrial Distributors, Williams flange-jacks are made in two sizes. The standard No. 20 for standard flanges 2 in. to 20 in. and for extra heavy flanges up to 12 in. The giant No. 30 for standard flanges 14 in. to 48 in. and for extra heavy flanges 10 in. to 30 in.

(12) Hose reel

A new and improved light-weight hose reel of the shock-proof type for carbon dioxide systems, available in capacities from 50 to 200 lb or more of carbon dioxide, has been announced by the C-O-Two Fire Equipment Company, Newark, New Jersey

This stamped brass and chrome plated



hose reel may be fitted with ½-in. high pressure hose of any length up to 125 ft or any length up to 100 ft of ¾-in. hose.

The hose reel and discharge horn may be installed adjacent to the C-O-Two cylinders or at a remote point.

The handle of the fire-fighting nozzle is equipped with the famous "squeez-grip" valve for controlling discharge of the carbon dioxide gas when working around a fire.

(13) Mercury switch

A new mercury switch has been developed by the Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota.

Less than 1½ in. long, the new switch is rated at 1 amp for 115 volts, a-c. The new device, one of several hundred different models made by Honeywell, is actuated by a snap tilt of 12 deg. using a single pole, single throw action.

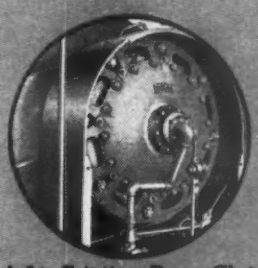
(14) Cast-iron Electrode

"Nicast" is a new P&H electrode reported by the manufacturer, Harnischfeger Corporation, Milwaukee, Wisconsin, to put cast iron in a class with steel for easing of welding and finishing. For maximum usefulness, Nicast was made to operate on either a-c. or d-c. Welds produced by "Nicast" are strong and non-porous and fully machinable in both the weld and fusion zone areas, it is asserted. The unusual machinability of "Nicast" makes it possible to drill, tap, mill, or machine weld deposits in any manner, shape, or form, it is said.

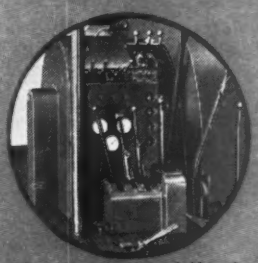
This new P&H electrode can be used to repair broken castings, build up worn castings, correct machining errors, and weld cast-iron to steel.

For Speed and Economy in Deep Drilling

Use an IDEAL Type 125 Consolidated Rig



Ideal Air Friction Drum Clutches Require No Adjustment



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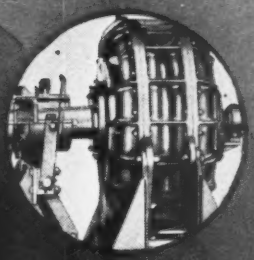
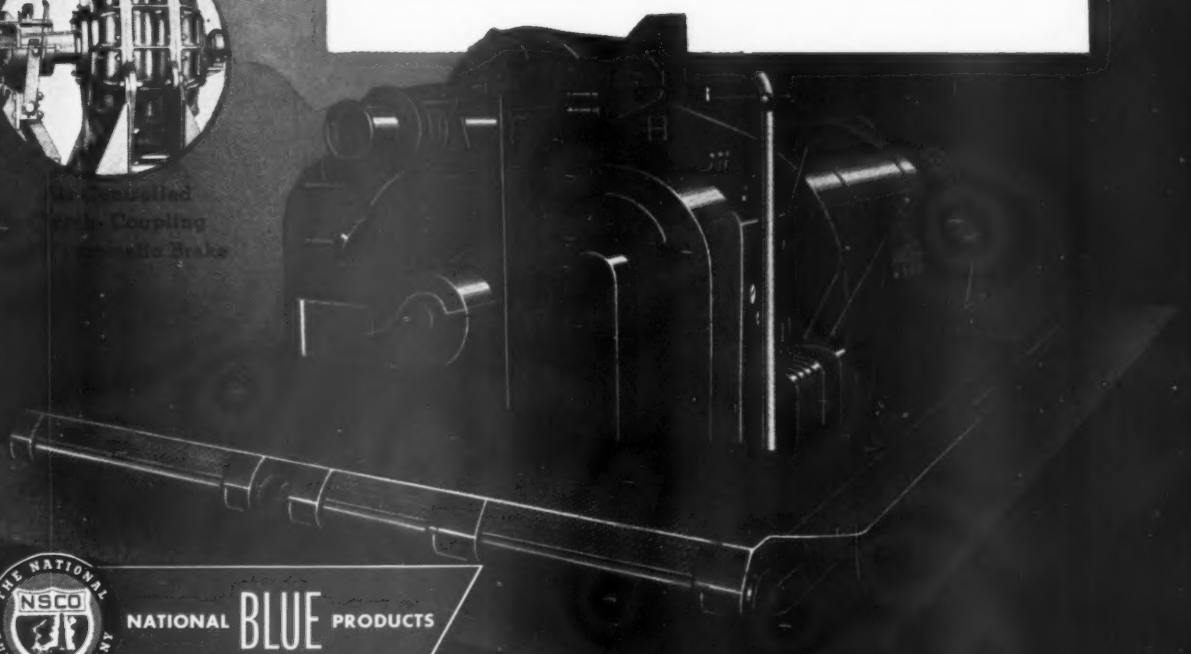


Air Controlled Hydromatic Coupling and Hydromatic Brake

National's *Ideal* Type 125 Consolidated Rig is used for most all deep Power Rig drilling. Made under rigid engineering and manufacturing practices, it will provide long life and it is equipped with all the essential features to furnish maximum speed and economy.

A few of its many advantages are listed below. Check them carefully. They mean extra profit for you.

- 6 HOISTING PLUS 2 EMPTY BLOCK SPEEDS
- 6 ROTARY TABLE SPEEDS AND 2 REVERSE
- IDEAL AIR FRICTION DRUM CLUTCHES
- FULL LUBRICATED HEAVY CHAIN DRIVES
- AIR CONTROLLED ENGINE THROTTLES
- HYDRAULIC COUPLINGS—OPTIONAL
- AIR CONTROLLED HYDROMATIC BRAKE DISCONNECTING CLUTCH



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(15) Tank car specifications

The American Car and Foundry Company, 30 Church Street, New York, New York, has recently issued a booklet on tank car specifications entitled "Tank Car Classifications for Ladings." Classes of tank cars authorized for shipping Interstate Commerce Commission regulatory commodities, and certain non-regulatory commodities, are given.

(16) Worthington equipment

Worthington Pump and Machinery Corporation, Harrison, New Jersey, has issued a number of bulletins on its equipment. Included are bulletins on general service and heavy duty rotary pumps; oil field and pipe line equipment; horizontal side pot pumps for refinery service; horizontal duplex power pumps for volatile liquids; aftercoolers for air and gas; horizontal duplex plunger pumps for general high pressure service such as water flooding in oil fields, and for pipe line and oil refinery service.

(17) Cycling plant brochure

The Fluor Corporation, Ltd., Los Angeles, California, has recently published a brochure on the South Coles Levee, California, Cycling Plant, which was designed and constructed by Fluor. This cycling plant, which is fully illustrated and described in a colorful, 32-page booklet, is typical of a fairly new development in the oil industry to increase the productive life of a field by injecting stripped gas back into the reservoir to maintain pressure and keep the oil deposit from disintegrating.

Besides the many photographs, there is a four-color, streamlined flow sheet in the center of the brochure that graphically depicts the various stages required in processing the well gas and condensate.

(18) Continuous specific gravity testers

A new bulletin recently released by Fischer and Porter Company, Hatboro, Pennsylvania, includes dimensional and operational details of an improved continuous liquid specific gravity indicator. The instrument is designed for continuous indication of fluid specific gravity in closed piping systems and it is reported that it has found considerable use in distillation work and in connection with all process systems in which draining of sample batches is considered tedious or hazardous.

(19) Feed water control data

New performance data is included in Bailey Meter Company's revised Bulletin 105-B, "Bailey Three-element Feed Water Control." This bulletin lists a number of advantages of the three-element system, shows chart records illustrating operation under difficult conditions, and gives a large list of users.

(20) Rex chains

Chain Belt Company of Milwaukee, Wisconsin, is now distributing a newly published bulletin on Rex steel fabricated and cast chains for every industry. All the company's standard chains are illustrated and briefly described. In addition, three pages of installation photographs show typical examples of how each style Rex chain is applied in industry; two pages illustrate standard attachments and their use, and one page contains information on Rex cast and cut tooth sprockets.

(21) "Karbate" heat exchangers

National Carbon Company, Inc., 30 East 42nd Street, New York 17, New York, announces publication of a new bulletin, Catalogue Section M8808, describing standard, seven tube heat exchangers of "Karbate" Impervious Graphite for use under highly corrosive conditions. The exchangers are available in three sizes of 4 ft 3 in., 7 ft 3 in., and 10 ft. 3 in. length with effective outside tube areas of 8.2 sq ft, 16.4 sq ft, and 24.6 sq ft, respectively. These "Karbate" exchangers have the well-known properties of high thermal conductivity and resistance to the action of most acids, alkalis, and other corrosive chemicals.

(22) Bristol instruments

A new bulletin listing more than 150 different items maintained in stock for immediate delivery has been published by The Bristol Company, Waterbury, Connecticut, manufacturers of recording and controlling instruments for industrial processes. The new bulletin, No. W1811, lists recording thermometers, pyrometers, pressure gauges, voltmeters, ammeters, and pH recorders. Also listed are recording controllers, indicating controllers, miscellaneous instruments, and accessories.

(23) Industrial fire hose

Hewitt Rubber division of Hewitt-Robins, Inc., Buffalo, New York, has released a new 6-page illustrated folder covering its general line of industrial fire hose. Products described include Monarch brand single and double jacket fire hose and Ajax brand mill hose. A special Ajax brand rubber-covered fire hose is recommended for use in chemical plants where moisture and acid fume conditions are met.

(24) Hydropress pump bulletin

"The Hydropress Pump" is the title of a new 12-page bulletin issued by the Byron Jackson Company, Pump Division, Los Angeles, California, for those who have big pressure, low volume pumping jobs, requiring maximum efficiency.

In three colors throughout the 12 pages, this bulletin (No. 46-6000) covers technical data, application pictures, cross-section drawings of parts, operation and design features, dimensional sketches, assembly procedure.

Pump sizes covered are 10, 12, and 15 in., with capacities of 20 to 300 gpm, and head range 55 to 250 ft per stage (to pressures of 5000 psi).

(25) Rotary pumps

Sier-Bath Gear and Pump Company, Newark, New Jersey, has followed up the recent introduction of its new Gearex rotary pumps with a 2-color catalog of facts. In two models—internal bearing for lubricating fluids and external-bearing models for non-lubricating fluids—Gearex rotary pumps have a wide variety of applications. Their applications to power plants, oil refineries, breweries, and many other installations are described in detail in the new catalog.

(26) Self-propelled arc welder

The Hobart Brothers Company of Troy, Ohio, has published a pamphlet describing the "Weldmobile," a complete self propelled gasoline engine driven arc welder.

(27) Wire line manual

An interesting reference manual and catalog on the uses and selection of wire lines for the oil country has been published by Rochester Ropes, Culpeper, Virginia.

About one-third of the manual is devoted to fundamental engineering data on wire ropes and general principles governing their use and selection. Several valuable tables and diagrams are included.

Following these is a section in which various oil country wire lines applications are discussed authoritatively. Recommendations are given for wire lines used in rotary drilling rigs, cable tool drilling, production, and refinery operations. Information on wire line fittings, terminals, and on slings is included.

At the end of the manual is a group of well-arranged wire line selection tables, prepared to simplify the choosing of correct lines for various purposes. The entire booklet is indexed for rapid reference.

(28) Cooper-Bessemer Type JM compressor

The Cooper-Bessemer Type JM compressor was designed and developed especially for heavy duty motor-driven service and is particularly adaptable to use in the chemical, process, oil and gas, manufacturing, mining, and construction industries. Available in six sizes and with a great variety of compressor cylinders, it offers a wide range of volumes and pressures for handling air or any gas. This compact and accessible compressor is built with one to six crankthrows, ranges from 500 to 2750 hp.

(29) Whirlwind air cleaner

Continental Air Filters, Inc., Louisville, Kentucky, has issued bulletin No. 101, featuring the Whirlwind oil bath air cleaner for oil and gas engines and air compressors.

Annual reports indicate great expansion program

By **ERNESTINE ADAMS,** *Associate Editor*

OIL companies are behind on construction programs and are bursting with buying power, according to a survey of annual reports released by leading companies in the industry, including large corporations and independent petroleum organizations.

EXCLUSIVE

Earnings have made new records despite limitations imposed by shortages of materials and labor. Surplus funds are piling up for over-due expansion and repairs.

Even in present disturbed world conditions an unprejudiced realist will find encouragement in the figures of the annual reports. The bouyancy of a demand that did not weaken in the face of sudden peace and reconversion, as predicted, has continued and strengthened.

The petroleum industry was never in a better economic position to meet the future. There is a stockpile of fresh knowledge from research that surpasses anything ever before amassed at one time. There are still untapped resources of petroleum supply both here and abroad. Labor on the whole appears more amenable and a constant checkrein is held on radical elements by the new Congress. Key men are back from the wars to fill the need for qualified technicians, which has helped the personnel situation. The Administration has cut war controls and Congress promises tax cuts.

This is a bright picture, indeed, but as The Pure Oil Company's annual report warns, "It would be unwise to accept any dogmatic opinions as to general business prospects in 1947 whether they emanated from eminent economists, financiers or statesmen."

Nevertheless the summary goes on, "However, it would not be too hazardous to say that indications are for a good demand for petroleum products, and The Pure Oil Company is in position to meet conditions as they may arise with the flexibility which is necessary for proper adjustments."

This is a general feeling in the annual reports, an attitude of cautious confidence.

● **New records made.** Financial records were made in many reports. Sunray Oil Corporation reported "earnings, which were the highest in the history of the company." Standard Oil Company (Indiana) reported the highest dollar value of sales in its history. Phillips Petroleum Company's gross operating and other income rose to a new peak.

"Establishment of new record in crude oil production, refinery operations, and marketing, made 1946 an outstanding peacetime year for Sun Oil Company and subsidiaries," states the annual report of that concern.

Annual report of the Imperial Oil Limited, Toronto, Canada, stated that the company manufactured and sold more products in 1946 than in any preceding year and made substantial progress in its large program for expansion of facilities and equipment.

The Texas Company, in the midst of all this bright prosperity, points out that if the oil produced in 1946 had been discovered at current discovery costs, profits would have been lower.

● **Expansion programs.** Evidence of pent-up expansion is contained in almost every report.

"Construction and reconversion work was delayed due to material shortages and by strikes and shutdowns in other industries," states the Union Oil Company of California.

"Material shortages prevented completion of scheduled extensions to the pipe line system," is a line from Phillips Petroleum Company report.

Although Sun Oil Company invested $28,400,000 during 1946, its report relates that the expansion program was drastically curtailed "due to Civilian Production Administration" regulations.

Among the large expansion programs are those made by the gas and pipe line companies. The pipe line branch of the oil industry is out to spend billions in the next few years. if it gets a green light from government and equipment manufacturers.

Concerns like Consolidated Natural Gas Company, which has planned a $50 million expansion program, have projects outlined that call for tremendous expenditures. The Consolidated annual report carried a graph of its production and purchases of gas that gives a vivid picture of the reason for the huge Middle West-East lines of supply. (Fig. 1.)

● **Construction progress.** Despite limitations on needed expansion, great progress was made in building and renovating the great plant of the petroleum industry.

Shell Union Oil Corporation's capital expenditures during the year for field development, refinery improvements, marketing, and other facilities totalled approximately $66 million as compared with $58 million in 1945.

"Despite difficulties in obtaining materials," reports Standard of Indiana and subsidiaries, "our capital expenditures were in the neighborhood of the estimate made in our last annual report and amounted to $159 million as compared with $77 million in 1945. . . . The construction and expansion program planned for the year 1947 will require ex-

FIG. 1. Consolidated Natural Gas Company annual report shows the organization's increase in gas purchases from Mid-Continent sources.

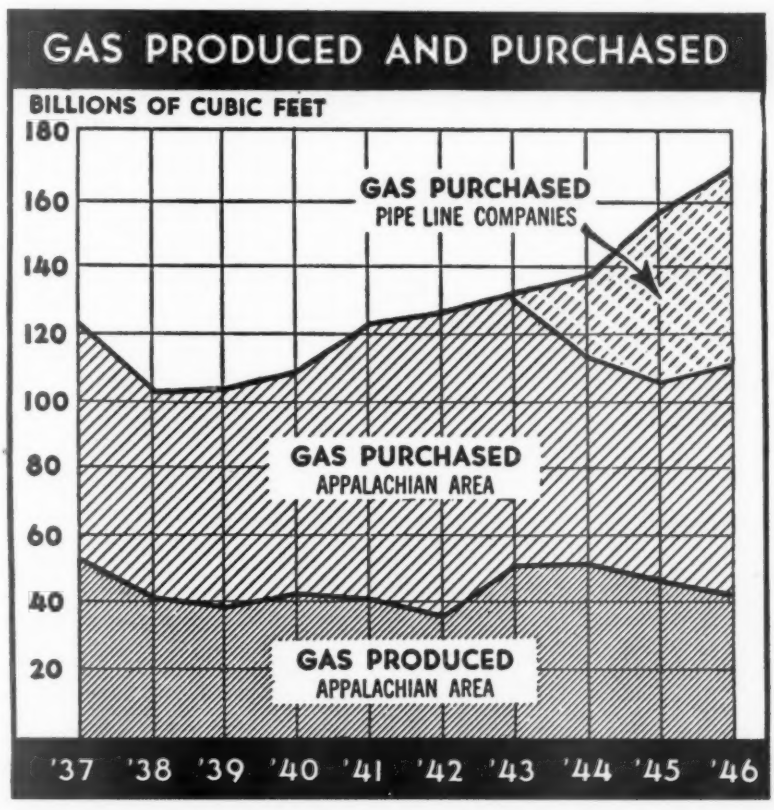
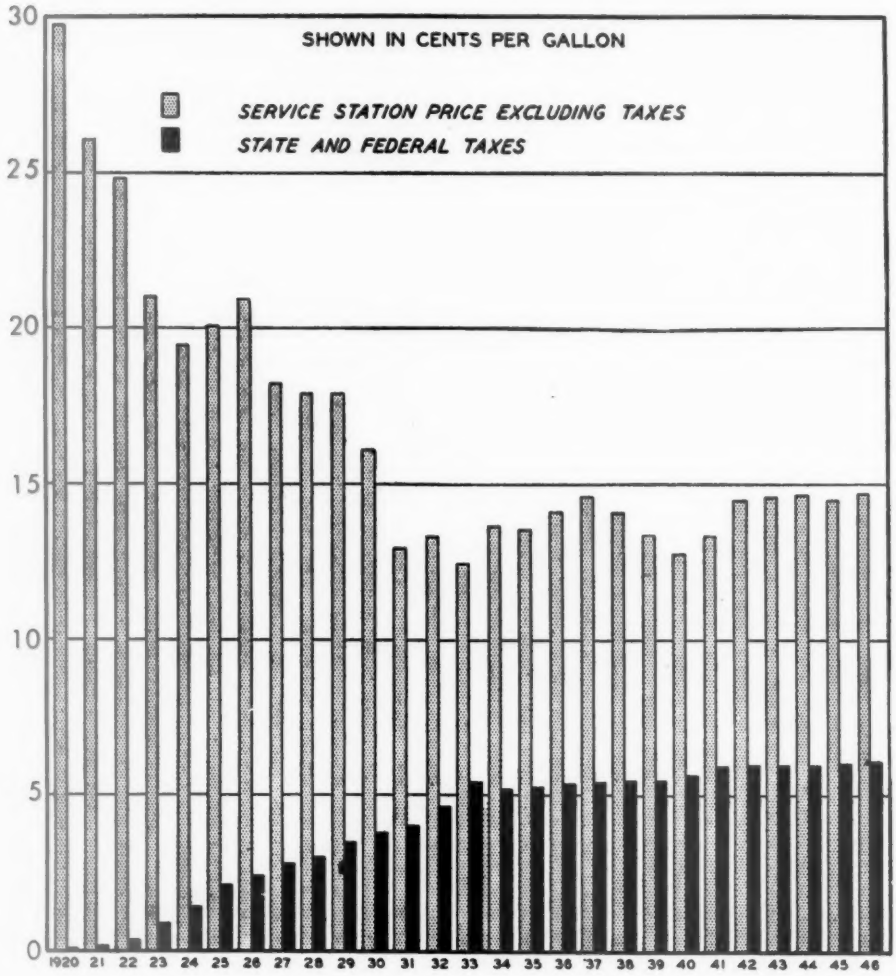


FIG. 2. The Texas Company's annual report has revealing graph on rise of taxes on oil companies' chief sales commodity, gasoline.


DECLINE IN RETAIL PRICES OF GASOLINE
AS COMPARED WITH THE
INCREASE IN STATE AND FEDERAL GASOLINE TAXES
ANNUAL AVERAGES OF FIFTY REPRESENTATIVE CITIES
IN THE UNITED STATES
SHOWN IN CENTS PER GALLON
SERVICE STATION PRICE EXCLUDING TAXES
STATE AND FEDERAL TAXES
30
25
20
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1920 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46

FIG. 3. U. S. Steel presents better comparison data than the usual consecutive years to show present condition of company.

PERIOD	SHIPMENTS (Million Tons)	OPERATING RATE (% of Capacity)	PROFIT (Per $ of Sales)
First Full Postwar Year (1946)	15.2	73	$ .06
5 War Years (1941-1945)	20.1	94	.04
5 Good Years (1920, 1923, 1926, 1928, 1940)	15.5	86	.10
5 Poor Years (1921, 1931, 1932, 1933, 1934)	6.9	33	— .06 (Loss)
22 Peace Years (1919-1940)	12.0	64	.05

(Data compared with those of 1946 are averages of similar annual measurements.)

penditures estimated at about $177 million."

Socony-Vacuum spent 386 million for capital investments in the United States in 1946 and close to $18 million was spent abroad.

States the annual report of Standard Oil Company of California under Capital Outlays: "Sums totalling more than $116 million were invested in the Company's future, in the form of additional producing, manufacturing, research, transportation, and marketing facilities; domestic oil exploration; and as investments in foreign subsidiaries and associates for their development."

● **Control and taxes.** Government controls and taxes came in for several verbal thrusts in the annual reports. The OPA and CPA were not overlooked. One company pointed out that the policies and practices of the 32 government authorities whose functions affected the oil industry were in many cases inconsistent with one another and at times there was apparent hostility between various government departments.

Figures were given on taxes and the reader could draw his own conclusions. Selecting a random case: Socony-Vacuum made a net income of $58 million. Federal taxes amounted to $67 million, state and local taxes, $20 million, and the company collected $97 million in gasoline taxes.

The Texas Company used a revealing graph (Fig. 2) to show the increase in state and federal taxes on gasoline.

● **Research.** Annual reports give more space this year to research and employe relations. The importance of the research departments is being felt with the acceleration of the industry's program. Nearly all annual reports comment on the accomplishments and plans of the men in the laboratories.

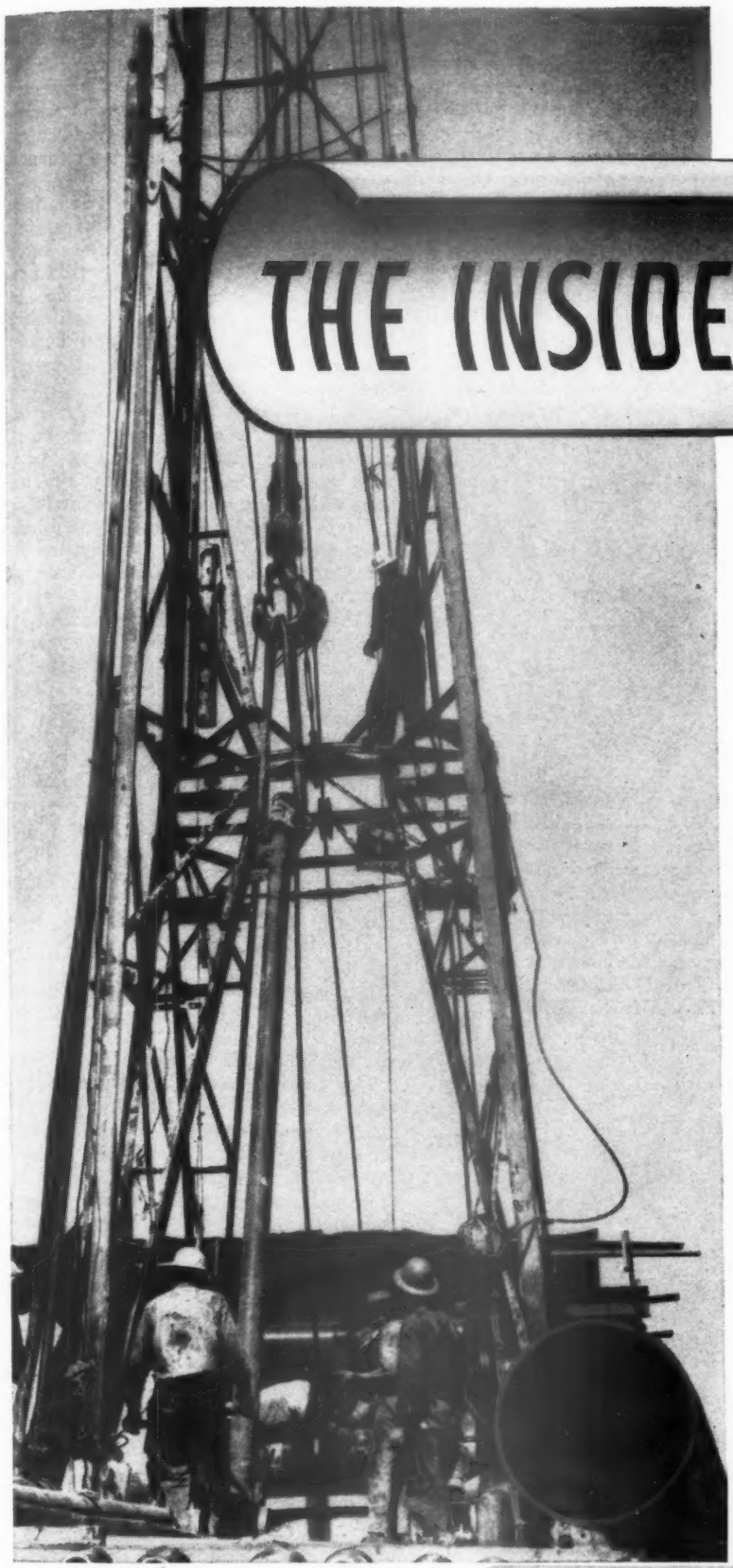
Reads the Lion Oil Company report, ". . . . a chemical research department is being established to explore the commercial possibilities of the many and diverse additional products which could be manufactured by the present plant or adjuncts."

From the Socony-Vacuum Oil Company report is: "The company and its subsidiaries continued to improve their research laboratory programs. . . . The research staff has been strengthened by the addition of a number of technical consultants from academic fields, by the establishment of Socony-Vacuum fellowships at ten accredited universities and the start of a plan for fellowships for qualified laboratory employees."

Union Oil Company of California gives an overall picture of 1946 research:

"Research activities covered a diversified field during 1946. The development of detergent types of soaps, plastics, insecticides, and pharmaceutical products were some of the projects under way.

"A hypersorption pilot plant was built and operated during 1946 to separate the component parts of petroleum gases. Interest in this project was industry-wide due to the commercial value of the chemicals that may be obtained from this source.



THE INSIDE STORY-

of Long Casing Life

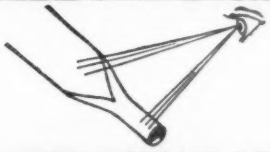
Drill pipe turns 'round and 'round—and is repeatedly raised and lowered INSIDE a string of casing. Tubing is lowered INSIDE it, too. And mud, water, cement, oil and gas travel up or down, as the case may be, INSIDE the string. That's why it's so important to be sure your casing walls are uniformly round, made of sound steel, free from thin spots and with strong, smooth joints.

You can be sure of ALL these qualities, and more, when your strings are made up with Republic Electric Weld Casing. Formed from flat-rolled steel, every square inch is uniform in wall thickness—and is open to inspection. Republic's improved welding process insures uniform size, concentricity and a weld as strong as the wall.

The outside story? Normalizing, cold forming and sizing further increase the yield strength of Republic Casing to provide uniformly high collapse resistance.

Remember: more than 130 million field-proved feet are backing your judgment when you order Republic Electric Weld Casing.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Bldg., New York 17, N. Y.



INSPECTED INSIDE AND OUT

Republic Electric Weld Casing and Tubing are made from flat-rolled steel, both sides of which can be inspected. Thus, the surface which becomes the inside wall is free from hidden defects.

REPUBLIC *Electric Weld* **NORMALIZED CASING AND TUBING**

REPUBLIC STEEL

Other Republic Products include Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

"Another project of interest was the operation of a hydro-desulpherization pilot plant for removal of the sulphurs which are present in so many Western crudes. The process looks promising and full-scale operation by this method is under consideration."

Two new "all purpose greases, were further improved. When put under test in actual commercial use, these greases gave superior protection against water and corrosion and greater stability over a wide temperature range.

"Research technicians continue to study secondary recovery methods to increase the ultimate yield of crude oil from known fields. Experiments indicate that less than 35% of the oil in an average field is recoverable by present methods of production.

"Methods of converting shale and tar sands into salable petroleum products are also being studied. Some authorities estimate that there is enough oil in the country's shale reserves alone to supply the nation with petroleum products for the next hundred years."

Shell Union reports research work in connection with exploration and production operations increased substantially.

Wartime research is now being directed to important peacetime activities, The Texas Company stated, and will be expanded.

● **Employe relationships.** A record of good relationships with employes was related in the majority of the annual reports. No serious difficulties, such as major strikes, were encountered during the year of 1946. Number of employes increased, a large percentage of which were men and women who had been granted military leaves and had returned to work.

Benefits had been continued and often new ones granted. Group insurance, sick pay, retirement plans, vacations with pay, etc., were increased. Union Oil Company of California estimated the cost to the company of these benefits, including Federal Old Age Benefits and Unemployment Insurance, was approximately $427 per employe.

Basic salaries and wages reached an all-time high. Many of the companies also voluntarily added cost-of-living bonuses when prices continued to rise and were still giving them at the end of 1946.

Higher costs for the industry required greater effort on the part of management. The Sun Oil Company statement shows what one organization did:

"Illustrative of the increased efficiency and productivity per unit that the Company has achieved is a comparison between 1941 and 1946. Between these two years wage rates had increased 50 per cent and material costs approximately 30 per cent.

"Yet during the first seven months of 1946 the price of gasoline, Sun's major product, remained substantially the same as in 1941. Completing the picture, the Production, Manufacturing and Marketing Departments increased their output, over all by about 50 per cent over 1941, with a 25 per cent increase in personnel."

Capital investment for each employe had risen for every company that reported on this point.

● **The annual reports.** Many companies have discovered that annual reports can be as attractive as any magazine and as interesting as any glimpse at the adventure of business in the United States. Annual reports today are likely to be well written, readable comment on the progress of the company, well illustrated with pictures and simplified graphs so that the reader doesn't have to be an accountant to know what happened to the finances of the reporting company. A few still turn out cryptic statistics and leave their stockholders and the public to figure them out as well as they can but this method is fortunately becoming rare.

In the U. S. Steel Company report a different comparison method was used that may be of interest to those who make up next year's annual reports. (Fig. 3). There has been great difficulty in obtaining comparison years that meant anything to indicate progress. U. S. Steel draws its comparisons to 1946, the first full postwar year, with the average of five war years, the average of five good years, the average of five poor years, and the average of 22 peace years. There is a much more accurate picture in this series of comparisons than in most attempts to set up one group of years as a measurement of normal business. ★★

Congratulations!
Bouquets to applaud new world depth drilling records in American oilfield exploration! ... But it is no longer news that Regan crown blocks and traveling blocks so frequently are identified with this record breaking drilling ... Deep well drillers know a good thing when they specify "Regan" equipment ... The same fine qualities now apply to the acceptance, by the industry, of the NEW AND COMPACT FORGED ALLOY STEEL COMBINATION HOOK.
Send for fully descriptive new Bulletin on the sensational new Regan Combination Hook.
And... have you seen Regan's new hook?
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Quality
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EXCLUSIVE MID-CONTINENT REPRESENTATIVES: Hunt Tool Company, P. O. Box 1436, Houston, Texas
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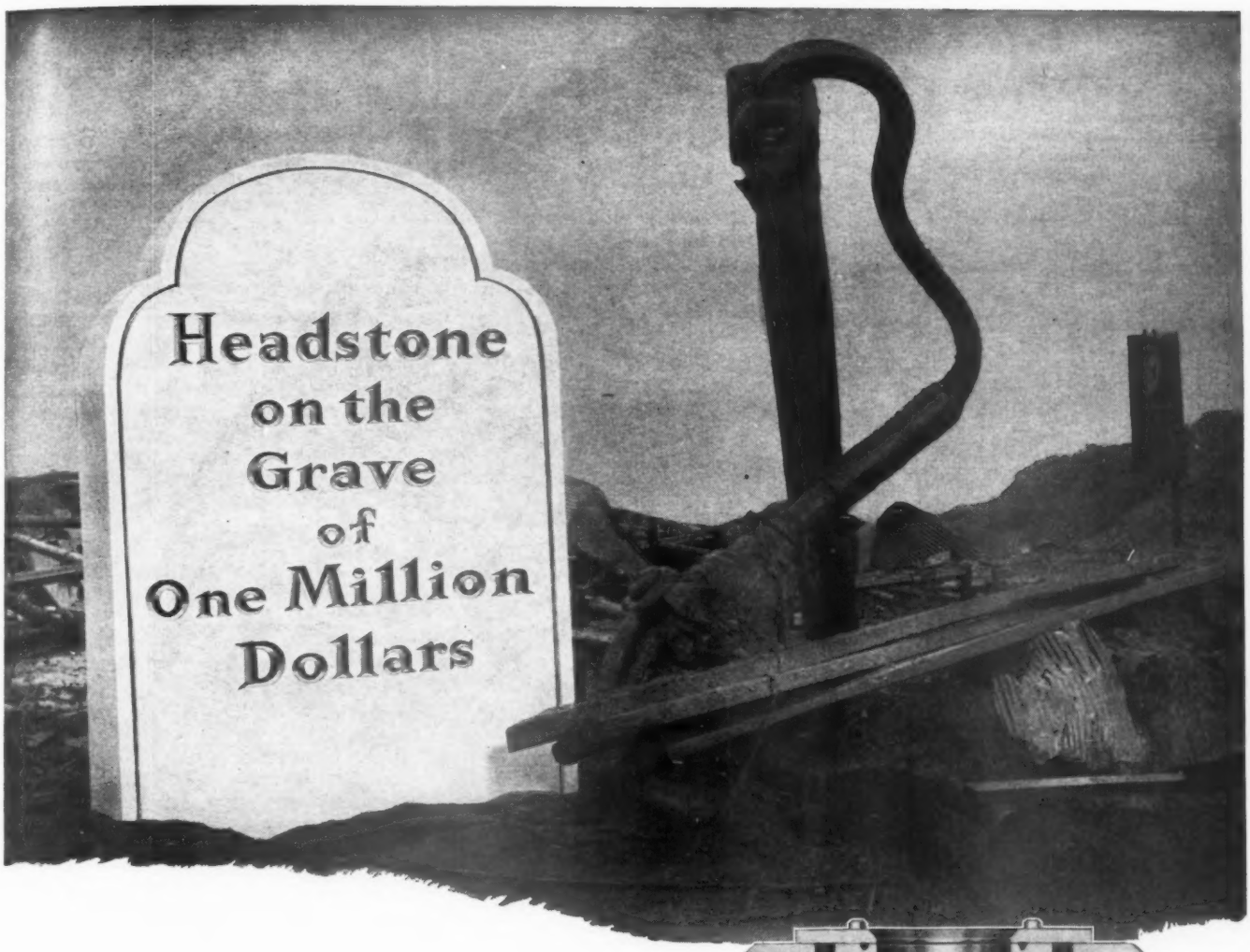
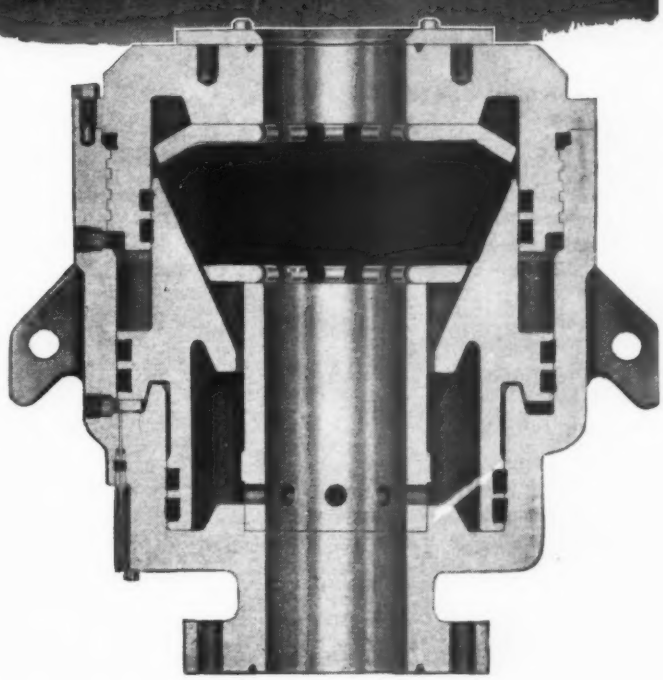


A MELANCHOLY MONUMENT to a moment's loss of control . . . derrick, drawworks and all, lost in a few seconds . . . a calamity which couldn't have happened with the new Hydril "GK" Blowout Preventer. Because the Hydril "GK"—which packs off securely around **any** drill-string or casing-string member, or even on **nothing at all**—gives complete protection every minute from the start of drilling to the setting of tubing, **without changes, additions or adjustments!** Complete details are given in our new Bulletin 946; send for it today. Hydril Company • 714 W. Olympic Blvd., Los Angeles 15, California.



HYDRIL "GK"—THE MOST REMARKABLE BLOWOUT PREVENTER EVER DEVELOPED!

Bases for drilling units made more rigid

EXCLUSIVE

THE Western Foundry and Iron Company of Wichita, Kansas, manufactures in quantity a rigid all-welded plate steel base that supports heavy power units to drive rotary drilling assemblies used extensively in the western petroleum fields.

The fabrication of bases of this type is a standard procedure with this company, and the staff prides itself on the fact that the rigid construction of the base has been proved time and time again by the drilling companies that subject this equipment to hard usage at all times. The drillers, for example, seldom have moving vehicles at their disposal when it is time to move to another drilling site. This, however, does not preclude the move for the rigid base supporting the power units is so constructed that it can be snaked from one site to another with no damage resulting.

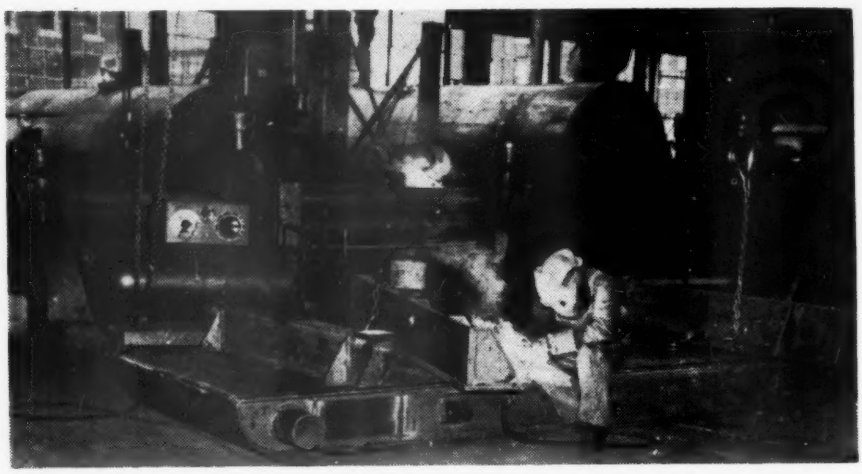
The base, (see Fig. 1), is 23 ft long and 54 in. wide, and is the original design developed some time ago when it was learned that a casting of this type base would be too difficult and would involve extremely high costs. Furthermore, if this base were cast it would have to be made in two parts, and would be much heavier than the welded-design base.

The weight of this all-welded base is 8 tons, and when the power units are attached the gross weight rises to 14 tons. The top plates, (see Fig. 2), are made of ½-in. plate steel, and the center support members are constructed of 12-in. H beams that run 65 lb per ft. The winch attachment assembly is made of heavy 6-in. pipe, welded in position. The engine rails are 1-in. steel plate, with lateral side supports made from 12-in. I beams. The radiator bracket is constructed out of 10-in. channel. All these materials are specified under SAE 1020.

Three of these all-welded bases can be built in 30 days, the Western Foundry and Iron Company reports. With all the parts cut and ready for welding skids, it can be completed in 8 hr, employing four operators.

The welding of these bases involves tacking before the unit is ready to be completed by the full force of operators who weld simultaneously on both sides. The work is welded downhand, using a flat technique at 300 to 350 amp, with one and two passes made on all side fillet welds, using ¼-in. "Fleetweld No. 7." This shielded arc electrode is made especially for operation on D.C. or A.C. for high speed welding of mild steel or low alloy steel, and is manufactured by The Lincoln Electric Company, Cleveland, Ohio, manufacturer of electric arc welding equipment.

After the engine brackets, motor rails, and radiator brackets are welded in place, the surface of these is machined in a large planer. ★★★



The operator shown above in FIG. 1 is making a side fillet weld on the base. FIG. 2 is the all-welded unit base that has a proved rigidity. The whole unit is subjected to hard usage at all times and it frequently is snaked from one drilling to another in western oil fields when no moving vehicle is available.

Twin Disc Model PH 42" Clutch (three-plate construction)

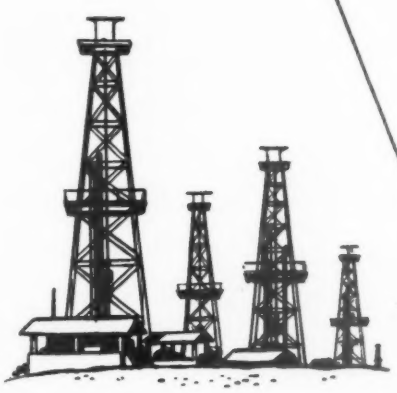
Higher Torque at lower speeds

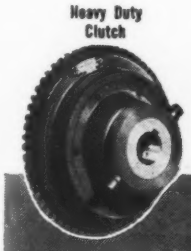
Greatly increased torque capacities for lower speed operations . . . below 100 rpm . . . have been attained by the Twin Disc Clutch Company in its new Model PH Air-actuated Clutch.

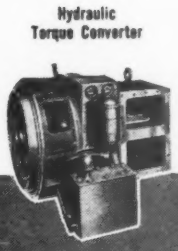
Ideal for drum drives and numerous other oil field jobs, the Model PH Clutch is offered in the 42" size with both two and three-plate construction. The three-plate clutch has a working torque capacity of 89,550 foot-pounds. The Model PH supplements the widely-used Twin Disc Model P Air-actuated Clutch, offered in sizes from 14" to 36". Horsepower capacities for the complete line now range from 75 to 1325 hp.

The new Air-actuated Clutch incorporates all the proved features and advantages of the smaller Model P Clutch. These include a high degree of resistance to heat deterioration . . . minimum maintenance and long wear-life attained by rugged construction and design which utilizes relatively few moving parts . . . elimination of lubrication problems and of need for adjustment due to friction wear.

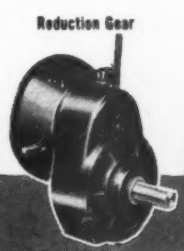
Write the Twin Disc Clutch Company, Racine, Wisc., for the new Bulletin No. 139A which covers the complete line of Air-actuated Clutches including the new Model PH 42" units. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).







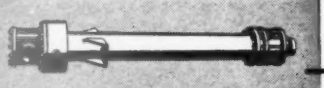
TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U.S. PAT. OFF.



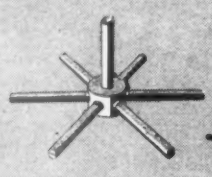
SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

Stop CORROSION

in chlorinating hydrocarbons and recovering HCl... with "KARBATE" BRAND IMPERVIOUS GRAPHITE!

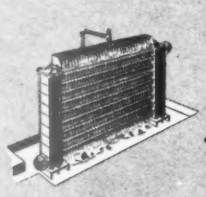


"Karbate" Reflux Condenser

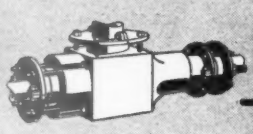


Porous Carbon Six-Arm Diffuser

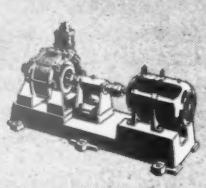
"Karbate" Series 70 Heat Exchanger



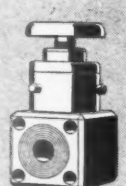
"Karbate" Cascade Cooler Absorber



"Karbate" Mixer



"Karbate" Centrifugal Pump



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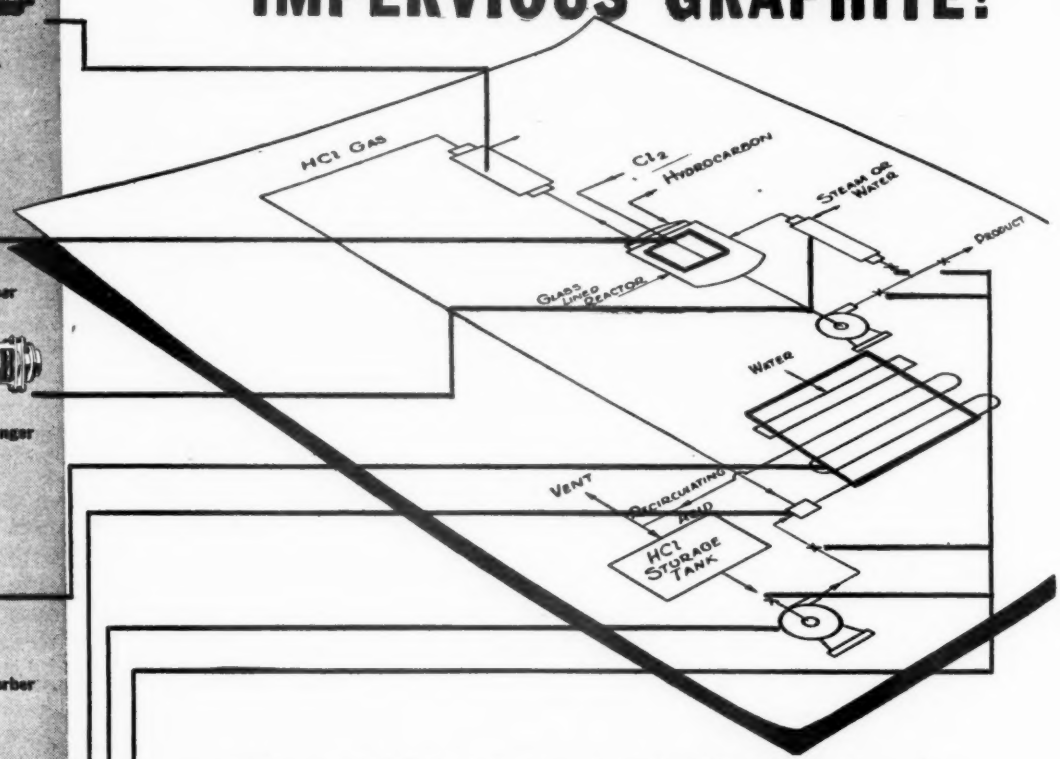

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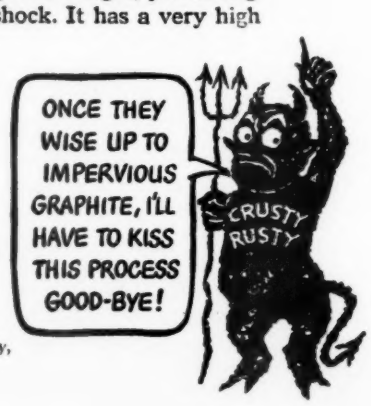

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the Petroleum Engineer's CONTINUOUS TABLES

a daily reference for operating men

INSTALLMENT No. 118

A valuable and regular feature of *The Petroleum Engineer,* the Continuous Tables, now in their tenth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.* Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have been developed as a result of suggestions for new tables, direct contributions and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue; 101-103, inclusive, in the January, 1946, issue; 104-106, inclusive, in the April, 1946, issue; 107-109, inclusive, in the July, 1946, issue; 110-112, inclusive, in the October, 1946, issue; 113-115, inclusive, in the January, 1947, issue.

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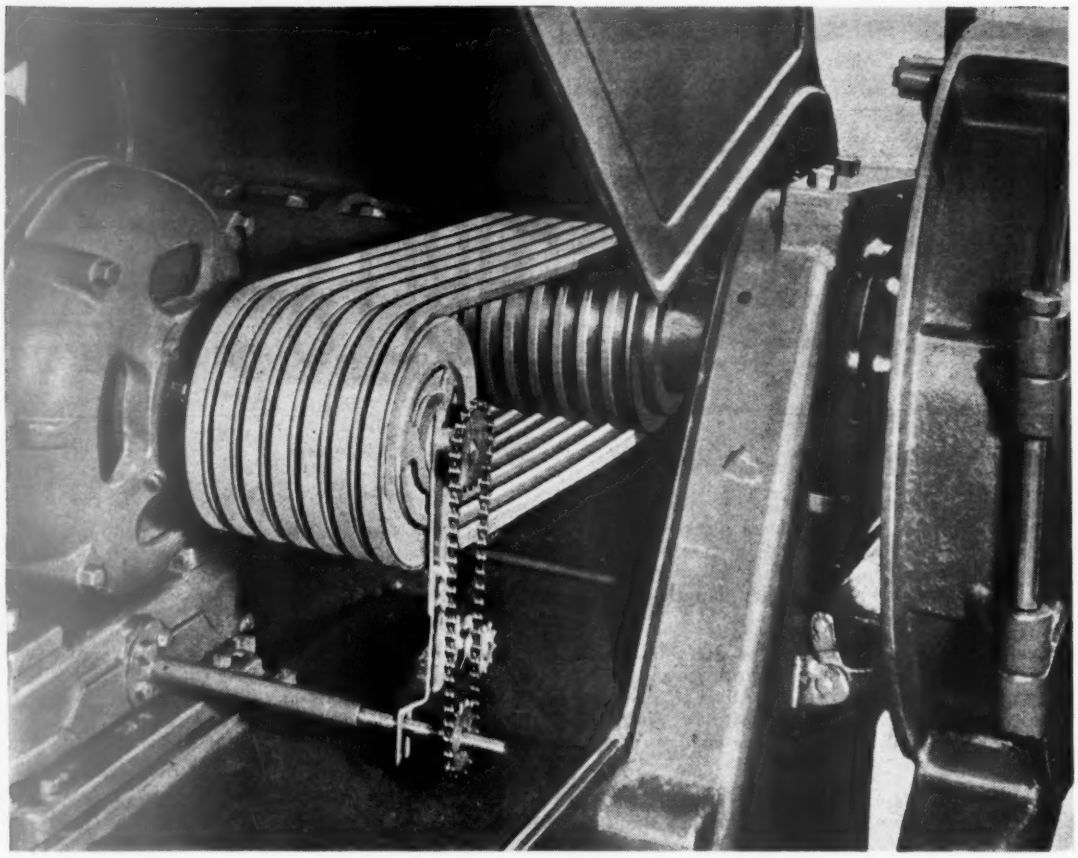

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IGNITION AND KNOCK CHARACTERISTICS OF HYDROCARBON FUELS

Some spark ignition work on a few fuels was published by the British Aeronautical Committee[8] and the information obtained is given in Table 1. These data are plotted in Fig. 14, the sound effects obtained being plotted on a sort of a decibel scale given at the bottom. At F/A ratios of less than 0.07, n-hexane gave the highest pressure, whereas benzene showed the lowest; however, although hexane peaked at this point, benzol continued to give higher pressures at higher F/A ratios, reaching a maximum at about 0.09 F/A. As can be seen at the bottom of the figure, the "knock" or noise intensity increased with F/A ratio for the conditions employed. These "knock" data are compared with various recent trace knock engine data, shown in the center of the figure. In the case of the fuels tested in the CFR Research engine, the peak knock intensity was found at an F/A ratio of about 0.075, which does not appear to line up with the British bomb data. An examination of the supercharged engine curve, however, shows that the trace knock point moves toward the rich side as the pressure level increases. If we assume that the maximum knock curve parallels the trace knock curve, then these data would appear to support those of the British workers.

Fig. 15 shows the pressure-time explosion curves actually obtained in the British work in the case of gasoline-air mixtures at various F/A ratios. It will be noted that as the F/A ratio increases, both the induction time, t, and the explosion time, t_2, become shorter. until knock is encountered. The maximum pressure reached also keeps increasing up to the knock point.

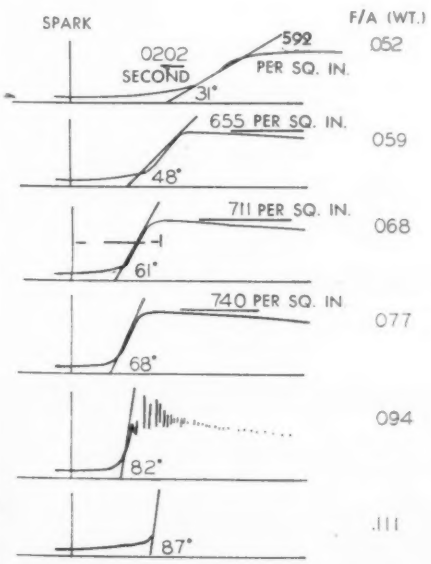

FIG. 15. Gasoline-air explosion records.

TABLE 1

Static spark ignition bomb data.

(100°C, 95 lb per sq in., initial conditions)
(Brit Aeron Res Comm data)

F/A	a°	t_1	t_2 (sec)	t_1+t_2	P (max), lb per sq in. abs	Max $\frac{dp}{dt_2}$	Noise
			n-Hexane				
0.059	33	0.043	0.042	0.085	671	16,000	Slight squeak
0.068	43	0.031	0.040	0.071	719	17,900	Just heard
0.076	58	0.027	0.036	0.063	720 (d)	20,000	Fairly loud squeak
0.093	78	(0.038)	....	....	(d)	....	Loud high short squeak
			Benzene				
0.060	28	0.053	0.040	0.093	629	15,700	Not heard
0.068	43	0.035	0.036	0.071	682	18,900	Not heard
0.076	51	0.027	0.030	0.057	720	24,000	Slight dull squeak
0.083	55	0.023	0.030	0.053	744	24,800	Slight squeak
0.094	63	(0.026)	(0.022)	(0.048)	741 (d)	33,600	Moderate squeak
0.109	76	....	....	....	(d)	....	High metallic knock
			Gasoline (Shell avia spirit, 1920, sp gr 0.727)				
0.052	31	0.096	0.074	0.160	592	8,000	Not heard
0.059	48	0.057	0.048	0.105	655	13,600	Not heard
0.068	61	0.032	0.038	0.070	711	18,700	Not heard
0.077	68	0.032	0.032	0.064	740	23,100	Slight whistle
0.094	82	(0.045)	....	....	(d)	....	Loud metallic ring
0.111	87	....	....	....	(d)	....	Loud metallic ring

(d) = detonation registered by pick-up.

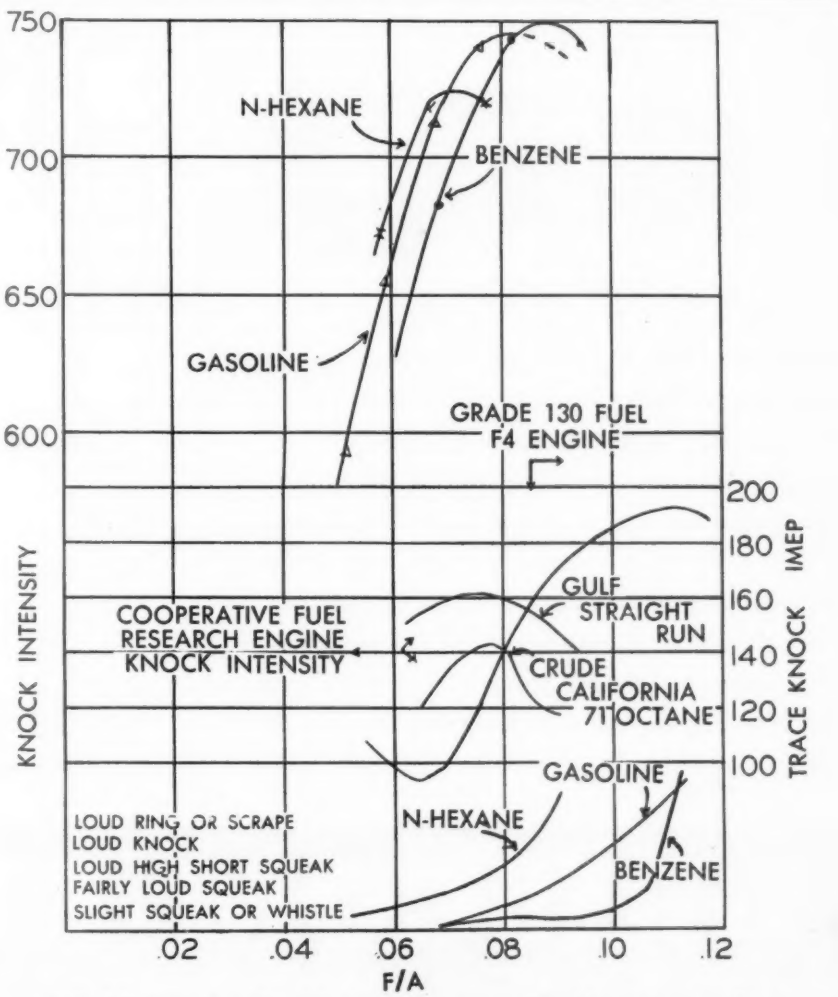

FIG. 14. Static bomb explosion data compared with engine results.

Note: References are shown on the last sheet of this series. Taken from the article, "Knock-free Power," by Peter J. Gaylor in the December, 1946, issue of *The Petroleum Engineer*, pages 43 to 48, inclusive.

HOW G-R has led in EVAPORATOR DESIGN and APPLICATION

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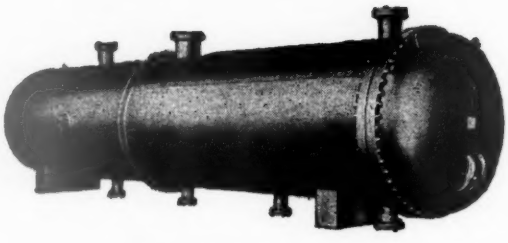
- THE FIRST *stationary evaporator*
- THE FIRST *"multiple-effect" system*
- THE FIRST *"associated" system*
- THE FIRST *"scale-shedding" elements*
- THE FIRST *"reducing valve" system*
- THE FIRST *"waste heat" evaporator*



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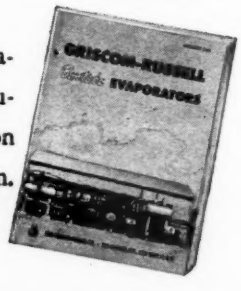
Investigate G-R Bentube Evaporators . . . write for Bulletin 364 and authoritative advice, without obligation, on your boiler feed purification problem.



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GAS LIFT DESIGN, INSTALLATION AND OPERATION

Formulas for spacing the upper valves are as follows:

1. Where static liquid level is near the surface:

$$S = \frac{P - D}{G}$$

Where:

S = spacing in ft,
P = available pressure, lb per sq in.,
D = differential desired, usually 100 lb per sq in., and
G = gravity of fluid in lb per sq in. per ft of height.,

2. Where static liquid level is below the surface, a distance in excess of S as calculated in (1):

$$S = S.L. + \frac{1}{G}\,\frac{P - 100}{R + 1}$$

Where:

S. L. = static liquid level, and
R = ratio of annulus volume over tubing volume.

Spacing between valves:

1. Differential control valves:

$$S = \frac{D}{G}$$

Where:

D = valve differential in lb per sq in.

This formula may be derived as follows:

Referring to Fig. 7:

S = spacing between valves, ft,
D = valve differential, lb per sq in.,
P = gas pressure, lb per sq in.,
H = static head required to open valve, lb per sq in.,
H_s = fluid head between valves, lb per sq in.,
G = gravity of fluid in lb per sq in. per ft of height.
$H = P - D$, and
$H_s = SG$.
P must balanuce $H + H_s$, so:
$P = H + H_s$ substituting
$P = (P - D) + SG$
Solving for S:

$$S = \frac{P - (P - D)}{G} = \frac{D}{G}$$

2. Surface controlled or specific gravity controlled valves:

$$S = \frac{P \times 0.7}{G}$$

Certain departures from the formulae given are possible.

The top valves in a string of automatic differential controlled valves can be spaced wider by 50 per cent more than the formula indicates, provided one is certain the working liquid level is down the hole. The bottom valves in a string of surface or specific gravity controlled valves should be set closer than indicated, if there is any doubt about the well working down to the bottom valve. Otherwise the operating valve may not produce enough and yet the next be difficult to operate due to the high productive capacity of the well at that point. Aside from these cases, the formulae given should be closely followed if efficient operation is to be attained.

In all cases, the pressures used in design should not exceed the normal line pressure, if trouble-free operation is to be obtained.

Intermitters are suitable for production rates of 1 bbl a day up, their maximum capacity depending on the gas pressure available and the size of the tubing. Intermitting intervals of less than 5 min are almost impossible of attainment. This permits 28 heads per day. The size of the head in barrels equals:

$$\frac{P}{G} \times C \times \frac{E}{100}$$

Where:

P = gas pressure at valve(lb per sq in.,
G = gravity of fluid lifted in lb per sq in. per ft of height,
C = tubing capacity, bbl per ft, and
E = lift efficiency.

Intermitter production rates attained from actual tests have run as high as 1000 bbl per day in 2½-in. tubing, and 400 bbl. per day in 2-in. tubing.

Surface controlled intermitters give low input ratios and effective performance in small wells. They are unlimited as to depth, successful installations having been made with lifts of more than 8000 ft.

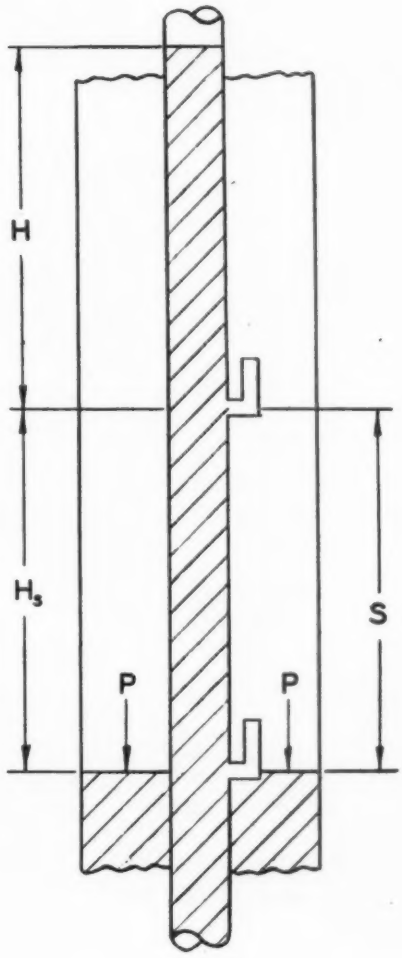

FIG. 7

Note: These data are taken from the article, "Design, installation, and operation of gas lift equipment," by Louis F. Davis, in the December, 1946, issue of *The Petroleum Engineer*, pages 60 to 77, inclusive.

Leadership through 44 years...

W. W. Vosper, inventor of Toledo Tools and now Chairman of the Board, is shown above in third row center (displaying large watch chain).

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Experience means a lot in building any product. In the field of pipe fitting—there's a wealth of engineering and manufacturing know-how behind all pipe tools and power pipe machines bearing the famous TOLEDO trademark!

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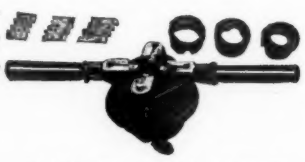

Toledo No. 1 Plain 1" to 2" Threader pioneered the Toledo line and is still preferred by many users today.

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PRECISION PIPE TOOLS

IGNITION AND KNOCK CHARACTERISTICS OF HYDROCARBON FUELS

Fig. 16 shows a graph of the pressures reached at the various angles and, as the values appear to fall on straight lines, extrapolation to 90 deg. is possible. It can be seen, then, that under the conditions of the tests benzene gives the highest theoretical pressure. At its "knock" point it exerts only 81 per cent of its theoretical pressure, and yet this is above those of other hydrocarbons that exert a higher percentage of their theoretical pressures. TEL would move the knock point up higher toward the theoretical limit.

Some additional spark explosion data for C_6 hydrocarbons obtained by Laure[9] are plotted in Figs. 17 and 18. Initial pressure was apparently 1 atm. It will be observed that although the maxima for pressure and rate of pressure rise were about the same for the hydrocarbons tested, the values differed considerably at given F/A ratios.

In Fig. 19 are plotted, first, the rate of rise of pressure $\frac{dp}{dt_2}$ the maximum pressure reached, and the S.I.T.'s for the various type fuels at various F/A ratios. Unfortunately, the data were obtained in different systems and the hydrocarbons compared are not the same ones, although they are similar in their expected performance.

Note: References are shown on the last sheet of this series. Taken from the article, "Knock-free Power," by Peter J. Gaylor in the December, 1946, issue of *The Petroleum Engineer*, pages 43 to 48, inclusive.

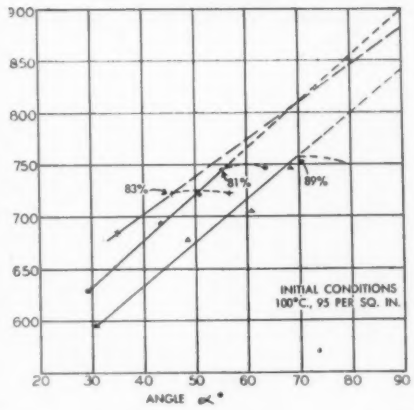

FIG. 16. Estimated theoretical pressures.

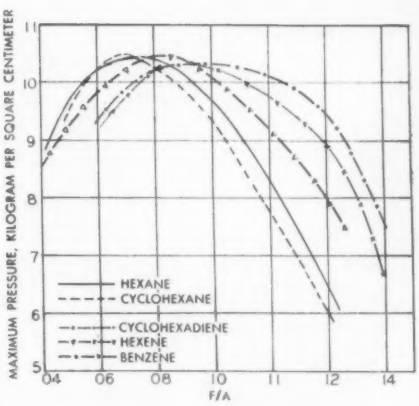

FIG. 17. Maximum pressures during explosion C_6 hydrocarbons in air.

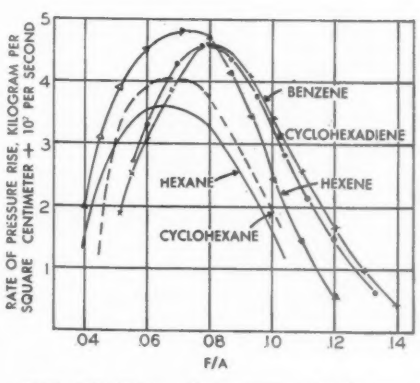

FIG. 18. Rate of pressure rise in explosion of C_6 hydrocarbons in air.

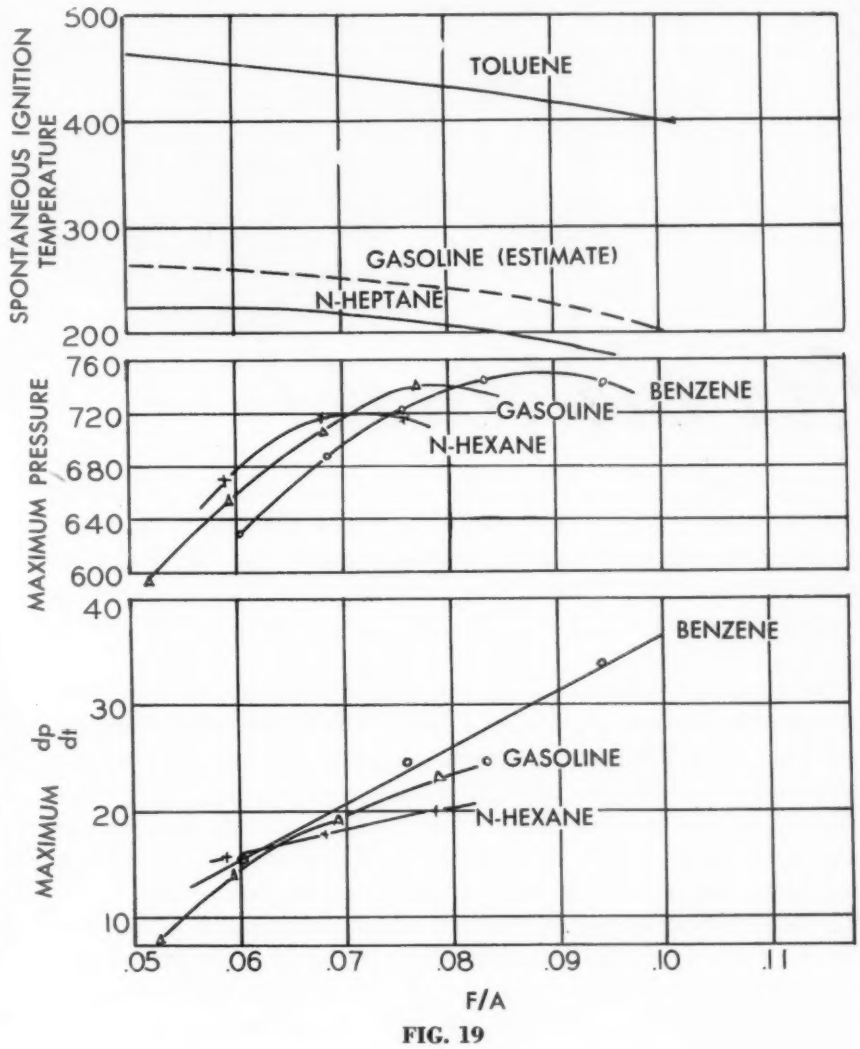

FIG. 19

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There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

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No internal wearing parts.

No valves, pistons, or sliding vanes.

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Saves floor space.

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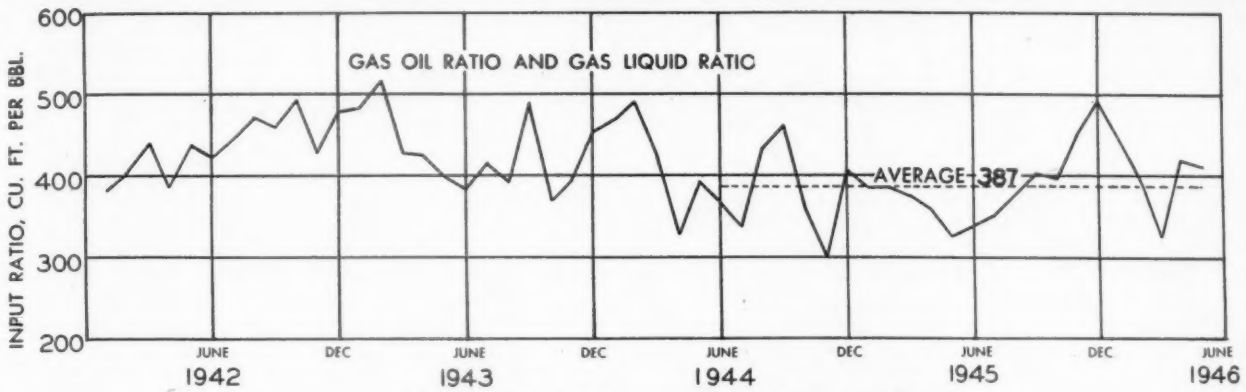
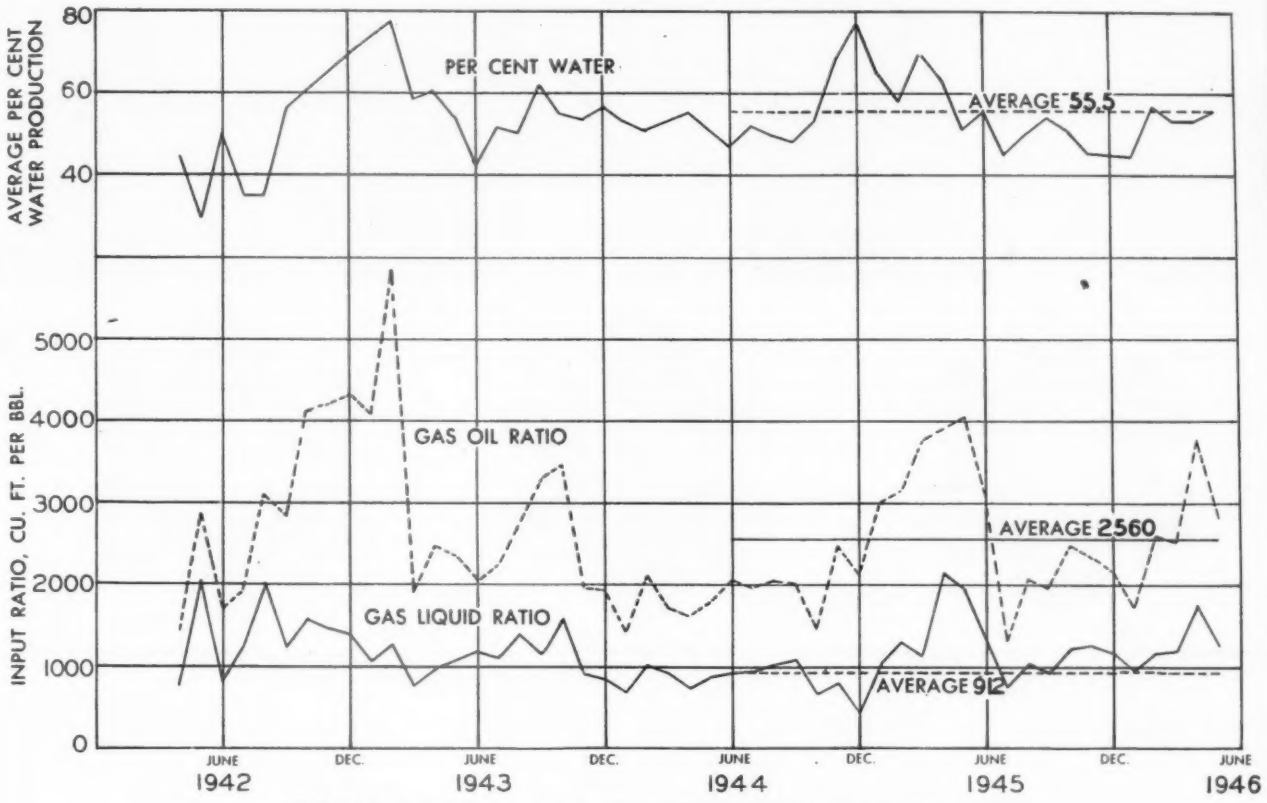
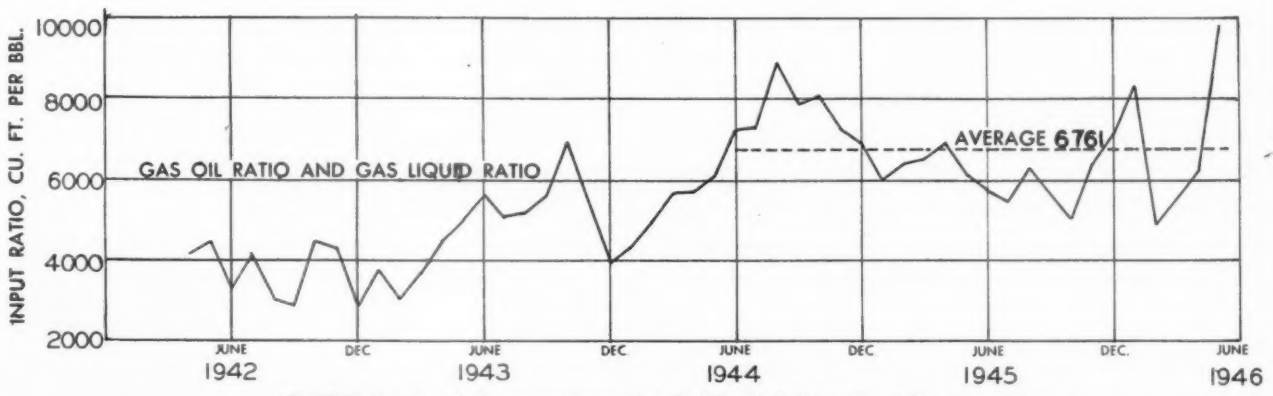
GAS LIFT DESIGN, INSTALLATION AND OPERATION



CURVE 1. Gas lift operations East Texas field.



CURVE 2. Gas lift opertions Neale field, Beauregard Parish, Louisiana.



CURVE 7. Gas lift operations South Ward field, Ward County, Texas.

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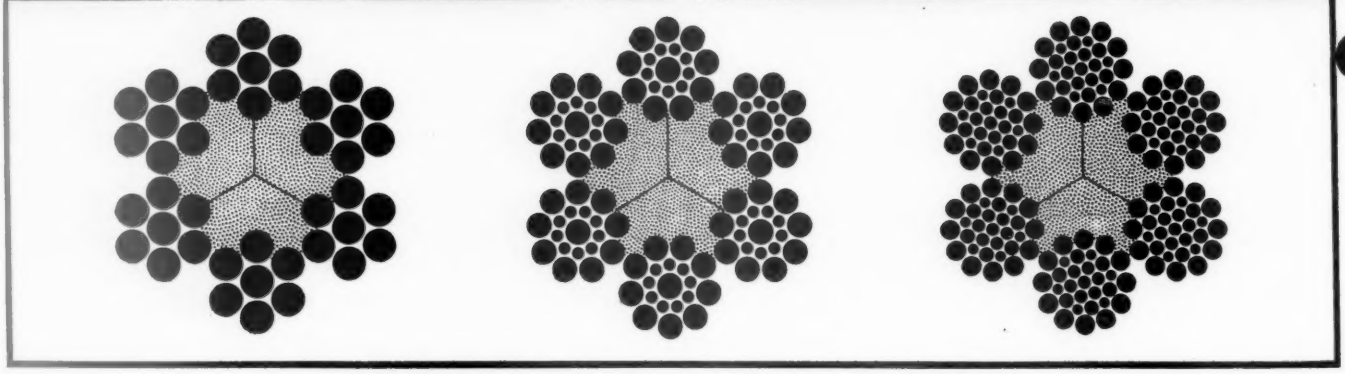

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IGNITION AND KNOCK CHARACTERISTICS OF HYDROCARBON FUELS

An examination of this series of curves will show that there appear to be three main competitive factors that are responsible for knock-free power. These are given in Table 3:

This competitive system results in a medium effect that can be termed as knock-free power. It is really a race between the energy input into the unburned portion of the charge and the amount of energy that the latter can store without "blowing up." These factors appear to be sufficiently independent to require individual determination for proper evaluation of the fuel.

Fig. 20 is a rough representation of these three factors for three classes of fuels: (1) Aromatic, (2) naphthenic, and (3) paraffinic, plotted against F/A ratio. The reciprocal of $\frac{dp}{dt}$ is given, for knock-free power is favored by slower combustion rate, and hence slower rate of heat build-up in the unburned portion.

On the basis of these considerations, then, the ideal gasoline would be one of high energy level, low rate of heat build-up, high S.I.T., and flat S.I.T. slope vs. F/A ratio.

It would be logical to ask just where inlet temperature fits into the picture. To obtain an answer to this, reference can be made to other data obtained by the British Aeronautical Committee, shown in Table 2, giving maximum pressures at the same F/A for gasoline and benzene at two inlet temperatures (100 C and 200 C). It will be noted that knock is *not* considered at all here. The figures show that an increase in inlet temperature reduces the maximum pressure, and that the reduction is greater in the case of aromatics. Hence, loss of power by increase of inlet temperature need not be attributed entirely to knock.

Some apparently unexplainable data obtained by Brooks[12] and shown in Fig. 21. The leaded fuel was found to go through a peak knock point at a richer F/A ratio than the clear fuel. When ozone was added to counteract the effect of the TEL, the knock intensity was brought back to that of the clear fuel, but the peak point was at an F/A ratio intermediate between those of the other fuels.

A possible explanation of the results is indicated in Fig. 22. As the maximum pressure would be unaffected by the small amount of dope, the only factors remaining that would be affected are burning rate and S.I.T. If we assume that TEL would lower the burning rate more at the peak point (as in Fig. 9) and the ozone brought it back to that of the clear fuel, and that the effect of TEL on S.I.T. is as shown (Cf. Fig. 13), while the ozone reduced the S.I.T. as shown, then the knock intensity could be estimated to correspond to the upper curves in Fig. 22, which are similar to those given by Brooks.

TABLE 2. Effect of intake air temperature on maximum pressure.

Initial temperature, °C	Initial pressure, lb. per sq in. abs	Pressure rise, lb per sq in.			
		Air-gasoline, 11 per cent rich	Per cent decrease	Air-benzene, 10 per cent rich	Per cent decrease
100	50	321	....	327	....
200	50	250	22.1	248	24.2
100	100	660	....	680	....
200	100	519	21.3	523	23.1
			0.8		1.1

TABLE 3. Factors determining knock-free power.

	Determines	Measured by	Determined by
I. Energy characteristics 1. Maximum pressure (due to maximum temperature and volume ratio)	Power level	Maximum pressure	Composition
2. Rate of combustion	Rate of heat build up in unburned portion	Rate of pressure rise	Composition (and structure)
II. Knock characteristic Stability	Point of spontaneous ignition of unburned portion	S. I. T.	Structure

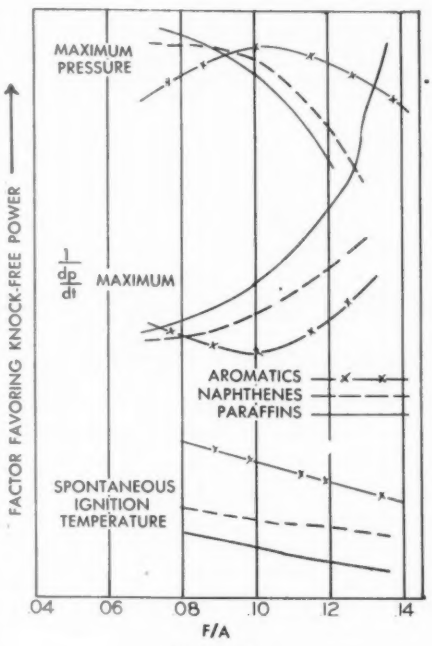

FIG. 20

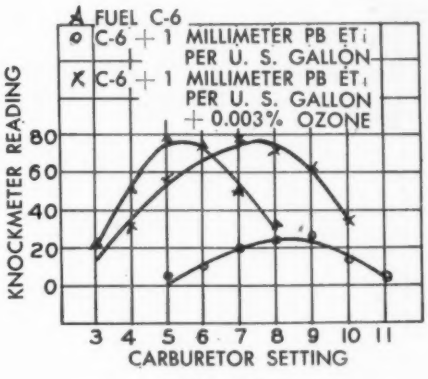

FIG. 21

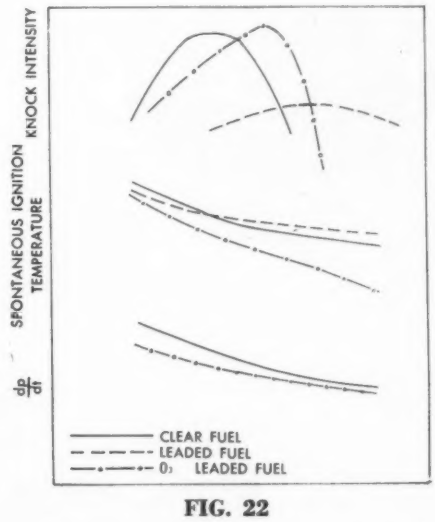

FIG. 22

1. Sweeney, *Petroleum Refiner* 10/44 p. 103.
2. Michailova et al., Compt. rend. (Doklady) 1936 II, (xi), No. 4 (90); NACA Transl. No. 813 (Dec. 1936).
3. Traver et al., *SAE J. 48*, 177 (1941).
4. Townsend et al., *Proc. Roy. Soc. 141A*, 484 (1933).
5. Brown et al., *Ind. Eng. Chem. 19*, 866 (1927).
6. Boyd, *SAE J.* 10/39 p. 421.
7. Terres, *Z. Angew. Chem. 44*, 513 (1931).
8. Fenning, *Brit. Aeron. Res. Comm. Rept.* 979, 9/25.
9. Laure, *Publ. sci. et tech. du Min. de l'air* No. 78 (1935).
10. Mohr, *Oel u. Kohle 12*, 713 (1936); *C. A. 30*, 8571.
11. Maxwell et al., *Ind. Eng. Chem. 20*, 1041 (1928).
12. Brooks, *J.I.P.T. 19*, 835 (1933).

Taken from "Knock-free Power," by Peter J. Gaylor, in *The Petroleum Engineer*, December, 1946.

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Can you charge any crude stock?	☐ YES	☐ NO
Are you getting maximum continuous crude throughput?	☐ YES	☐ NO
Is your heat exchange efficient?	☐ YES	☐ NO
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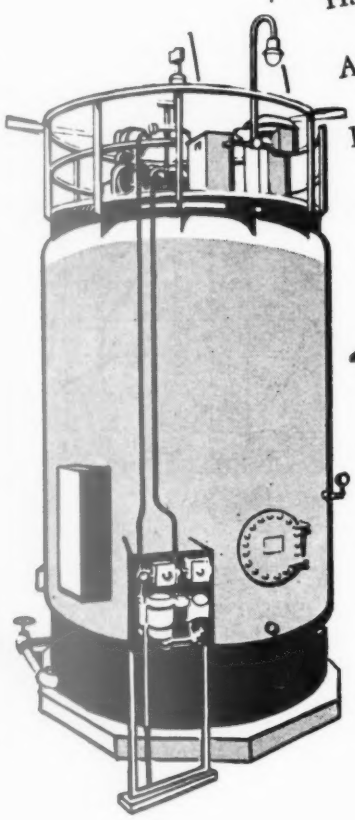
Are maintenance costs low?	☐ YES	☐ NO
Have you eliminated or reduced tank bottoms to a minimum?	☐ YES	☐ NO
Are you getting maximum continuous time on stream?	☐ YES	☐ NO
Can you operate on a time schedule?	☐ YES	☐ NO



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GAS LIFT DESIGN, INSTALLATION AND OPERATION

CURVE 3. Gas lift operations Dickinson field, Galveston County, Texas.

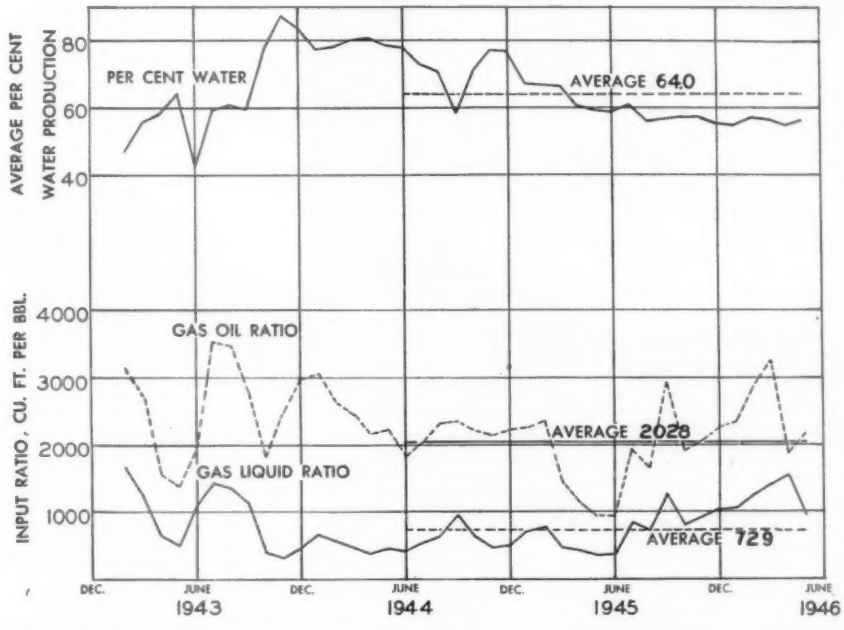

TABLE 1

Field	Injected		Per cent water	API gravity oil	Specific gravity of liquid lifted	Feet of lift	Ft-lb required to lift 1 bbl at 100 per cent eff, thousands	Injected gas pressure	Actual ft-lb per bbl used, thousands	Eff of lift, per cent
	Gas-oil ratio	Gas-liquid ratio								
East Texas	387	387	negligible	39	0.830	2500	726	270	2,428	29.9
Neale	2560	912	55.5	37	0.935	5000	1636	600	7,207	22.7
Dickinson	5908	466	92.7	37	1.025	2500	897	600	3,682	24.3
Greta	2028	729	64.0	23	0.994	2000	696	800	6,196	11.2
Seven Sisters	3043	1141	65.3	23	0.994	2000	696	300	7,400	9.4
Aransas	1861	530	71.5	43	0.972	3500	1191	650	4,276	25.5
South Ward	6761	6761	negligible	32	0.865	2300	696	380	48,848	1.4
Goldsmith	3535	3535	negligible	36	0.845	3500	1035	480	27,230	3.8

Figures in this table are for the period from June, 1944, to May, 1946, inclusive, except for Goldsmith, which is from June, 1945, to May, 1946, inclusive.

Curves 1 to 8, inclusive, provide data on the operation of gas lift equipment in several areas by a major operator. Table 1 gives lifts, efficiencies, etc. The period covered by these computations is from June, 1944, to May, 1946, inclusive. These are discussed in detail, as follows:

Curve 1 shows data on gas lift operations in the East Texas Field. The wells are in the southeast portion of the field and are producing by means of flow valves and wire line intermitters. Gas is supplied at approximately 270-lb. pressure and the average lift is about 2500 ft. Very little water is lifted, most of the production being on the east side of the field where the wells are water free.

Curve 2 represents gas lift operations in the Neale field, Beauregard Parish, Louisiana. The wells in this field are largely equipped with the bellows type casing pressure controlled intermitters. Productivity indices are poor and the average lift is estimated at 5000 ft. Efficiency is 22.7 per cent. Gas-oil ratios fluctuate violently due to the varying percentages of water produced, but injected gas-liquid ratios are fairly constant and good performance is obtained, as can be seen from the efficiency quoted.

Curve 3 represents gas lift operations in the Dickinson field, Texas Gulf Coast. Here the average lift is 2500 ft, efficiency 24.37 per cent. Large quantities of water are produced, the average water production being 92.7 per cent for the last two years. Gas-oil ratios fluctuate widely, as would be expected, but the gas-liquid ratio remains fairly constant at approximately 465 cu ft per bbl. The wells are equipped with automatic differential type flow valves, casing pressure controlled intermitters, and wire line intermitters.

Curve 7 represents production in the South Ward field, Ward County, Texas. Lift is 2300 ft., water production is negligible, efficiency is 1.44 per cent, injected gas-oil ratio 6761:1. This is stripper production, the wells producing from 3 to 10 bbl a day. They are all equipped with wire line intermitters and produce from the bottom of the hole. Gas-oil ratios are high, for the light loads make considerable afterblow mandatory in order to obtain the production.

Table I lists all the operations just described and shown in Curves 1 to 8. The lifts given in this table were determined by using available pressure data and field experience and tests.

If it is desired to estimate probable ratios in a new area, they can be approximated by selecting a field given in Table I, where the conditions most closely fit the case in question, and adjusting the values given to local conditions. It is safe to assume that in areas where there is an appreciable amount of liquid to be lifted, efficiencies can be obtained of from 20 to 30 per cent. If the product is of the stripper type, efficiencies will be low, from 1 to 5 per cent.

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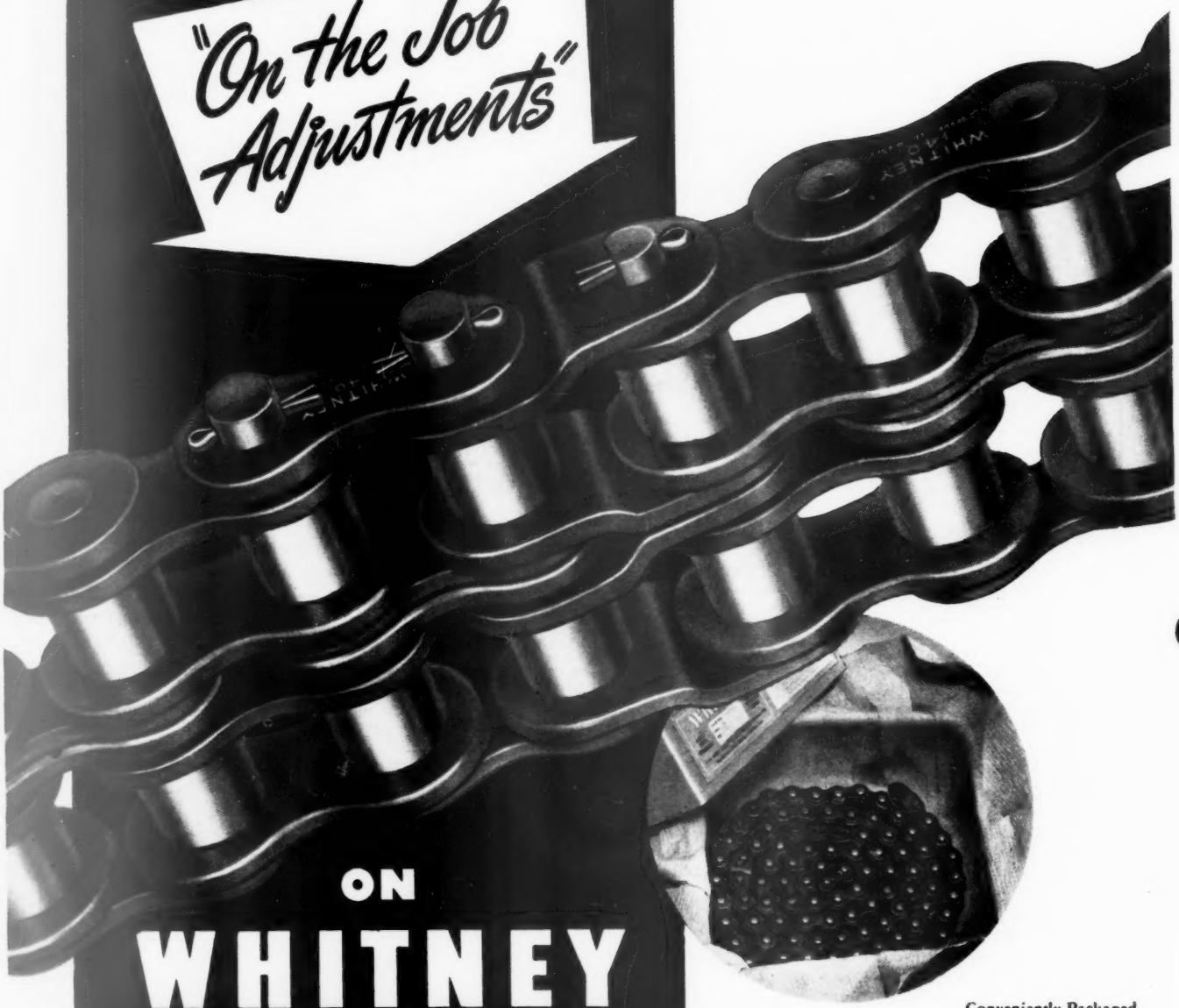

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CENTRIFUGAL GAS COMPRESSOR OPERATING DATA

The centrifugal gas compressor consists, in general, of a short heavy shaft, to which are attached impellers or wheels. There may be anywhere from one to perhaps 11 or 12 wheels on this shaft.

This shaft is carried in sleeve or journal type bearings and these bearings, in combination with a thrust bearing, are the only moving parts in actual contact.

The stationary part of the machine consists of the external casing and diaphragms, which form the internal diffusers and return passages; certain auxiliary items such as the lubrication system, internal seals and a special shaft seal to prevent the leakage of gas or air complete the unit.

In passing through the first rotating wheel or impeller, static and kinetic energy are imparted to the gas. After the gas leaves the wheel tip, it passes outward through a diffuser wherein the gas velocity is diminished, and part of the kinetic energy gain in the impeller is transformed into additional static energy, or pressure. The gas then passes through the return channel, and enters the second wheel and subsequently the second diffuser where this process is repeated and additional static pressure results.

● **Operating characteristics.** Some of these characteristics can best be demonstrated by a set of typical performance curves. (Fig. 1.)

These are curves taken from an actual installation. They are plotted: Intake volume in cu ft per min measured at intake conditions vs. compression ratio, and vs. shaft horsepower. Each curve represents a given speed, specifically 5500, 5300, 5100, and 4900 rpm. This 3-wheel compressor is operating on air, entering at 14.7 lb per sq in. abs and 100 F.

This point is the actual operating design condition, and corresponds to a volume of 30,000 cu ft per min at a compression ratio of 2.225 at 5300 rpm.

As you will notice, a considerable variation in capacity at constant compression ratio is obtained by a small speed variation. A 50 per cent reduction in capacity is obtained by reducing the speed to 5050 rpm—maintaining a constant compression ratio.

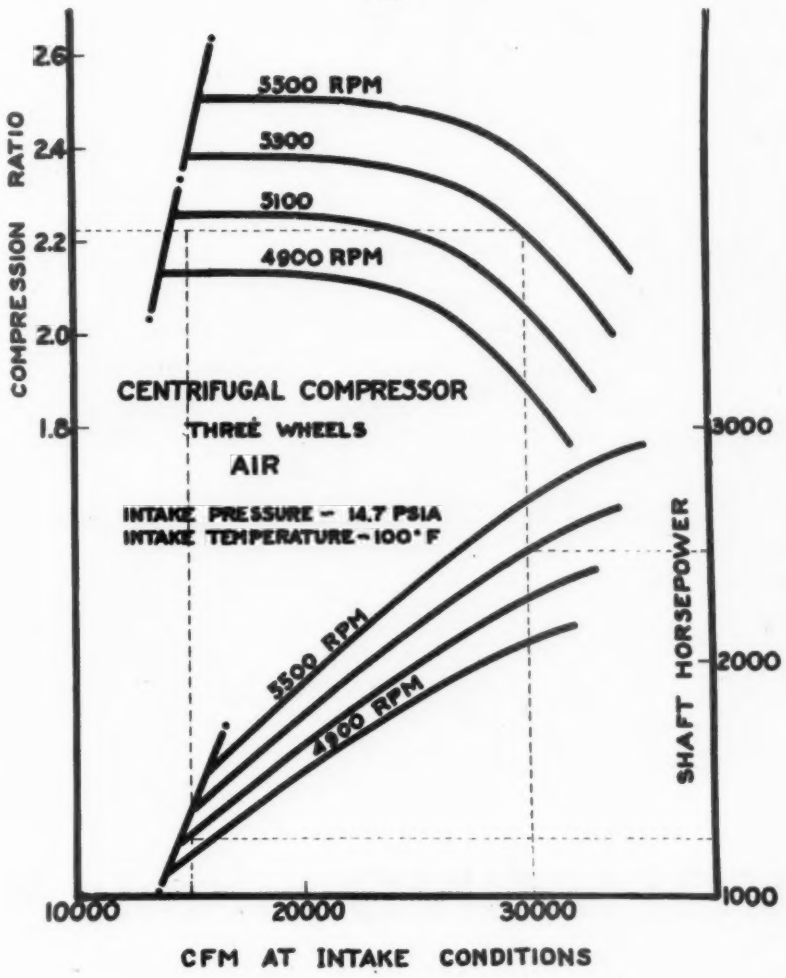
At 30,000 cu ft per min, or 100 per cent volume requirement, the shaft horsepower is 2470. At 15,000 cu ft per min, or 50 per cent volume, the power is only 1245 hp, or approximately 50.5 per cent of full load horsepower. Thus, it is evident that the power requirement is almost in direct proportion to the load demand.

Furthermore, there is great flexibility as regards variable suction pressures. In this same compressor, and without any internal or external modification, th compression ratio can be increased to overcome a reduced suction intake, simply by increasing the speed. Assuming the same 30,000 cu ft per min intake volume is to be maintained, the compression ratio can be increased 2.225 to 2.38 simply by increasing the speed from 5300 rpm to 5500 rpm.

There is additional flexibility in being able to handle gas streams of varying molecular weight. This is achieved, likewise, simply by speed variation.

Fig. 2 illustrates what can be expected of compressors of three, four, and six wheels operating on various gases.

FIG. 1.



	3 WHEELS	4 WHEELS	6 WHEELS
AVG. NAT. GAS SP. GRAV. = .70	1.8	2.2	3.0
AIR	2.2	2.8	3.8
PROPANE	3.4	5.0	9.0
BUTANE	4.8	7.6	14.0

FIG. 2. Nominal compression ratios—100 per cent compressor revolutions per min.

Taken from the article, "Developments in centrifugal gas compressor field," by H. M. Shedd in the December, 1946, issue of The Petroleum Engineer, *pages 144 to 148, inclusive.*

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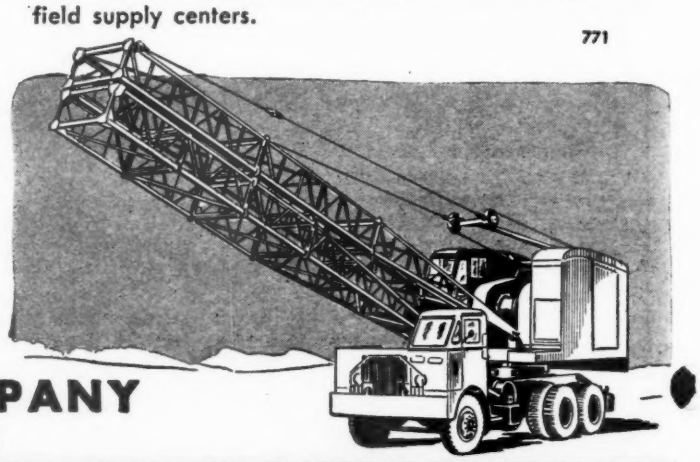

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HEAVY-DUTY CONSTRUCTION EQUIPMENT

How a well is drilled in affects profit and payout

By **K. MARSHALL FAGIN,** *Field Editor*

THE completion of a well begins when the drill reaches the cap rock above the producing formation and ends when the well is brought in or abandoned.

EXCLUSIVE The methods, materials, and equipment used during the completion period can "make" or "break" an operator, especially in fields where the natural conditions in the producing formation are such as to make successful well completions difficult.

Great improvements have been made in well completion practices in recent years that enable operators to "bring in" profitable wells, whether producing from relatively shallow oil and gas saturated formations or from deep hydrocarbon-saturated formations that would have been passed up as non-commercial in former times. Even today, however, many operators still fail to take full advantage of the latest methods of completing wells, while other operators, using these latest methods, are able to move in and complete profitable producing wells.

As completion practices have such a large effect upon initial production, ultimate lifting costs, the economic life of a well, and the ultimate profits obtainable by drilling and producing a well, it is extremely important for the operator to select the method that will enable him to take full advantage of the natural conditions in the producing formation and obtain the highest initial production rating.

● **Initial production—a measure of profits.** Although the methods of determining the initial production have been altered through the years to prevent the waste of oil and gas and damage to the wells, the initial productivity rating of oil and gas wells is still one of the best yardsticks available to indicate their value.

When other factors are known, the initial production is of prime importance in the prediction of future production, the economic life, and the ultimate profits of a well. It indicates, first, whether a well has been completed properly or poorly in the producing formation; second, whether it is likely to produce for a long or short period of time before remedial work is necessary; and third, whether it is likely to produce a large or small quantity of oil and gas and/or condensate and gas.

In general, some time-honored rules that apply to wells in a given reservoir, are: 1. The higher the initial production, the higher the ultimate production. This rule is recognized in many proration formulas by allowing wells with high "potentials" to produce more per day or per month than wells with low "potentials." It is not always applicable, however, in water drive or gas cap drive reservoirs.

2. The higher the initial production, the longer the well will produce. This rule, does not always apply in water drive or gas cap drive reservoirs.

3. The higher the initial production, the greater the well will be worth as an investment. The widespread introduction of proration and greater recognition of the obligation of operators to produce in proportion to the oil and gas in place is modifying the applicability of this rule. One thing of which an operator can be certain, however, is that the initial production is an indication of the ease with which a well can produce, and, therefore, an indication of whether the producing cost will be high or low.

It is axiomatic in most fields that wells with high initial production will produce more oil and gas and/or condensate and gas and last longer than wells with low initial production. Oil wells that have been completed without due regard for an expanding gas cap or encroachment of bottom water are, however, exceptions to these rules.

● **Natural reservoir and well completion factors.** Factors that affect the initial production rating of wells are classified under two heads in Table 1. The important natural reservoir factors are shown in list "A." These are the uncontrollable factors operators must consider in planning the completion of a well. Under list "B" in Table 1 are included most of the well completion factors that are wholly within the operator's control. The attention paid to these factors in the light of the natural reservoir conditions will determine the success of a well completion. Lack of attention to these factors often results in damage to a well—marked by low initial production or even failure.

TABLE 1.

A. Natural reservoir factors beyond operators' control that affect the initial production.

1. Porosity of formation.
2. Reservoir pressure and temperature.
3. Thickness of producing formation.
4. Gas, oil, and water content.
5. Permeability of formation.
6. Level of gas-oil contact.
7. Level of water-oil contact.
8. Viscosity of reservoir fluids.
9. Shale breaks or "tight" layers.
10. Bentonitic or heaving shale.
11. Thief sands or formations.

B. Well completion factors within operators' control that affect the initial production.

1. Type and characteristics of mud.
2. Mud pump pressure and volume.
3. Elapsed time from drilling in to final completion.
4. Total depth or plugged-back depth.
5. Area of producing formation opened.
6. Acid, chemicals, or shots used.
7. Efficiency of clean out methods.
8. Efficiency of liner and well equipment.

The importance of these factors is being recognized by an increasing number of drilling and production men, including engineers and geologists. This is resulting in greater attention to:

1. Well logging and coring tools.
2. Drilling mud control.
3. Selection of casing point.
4. Cementing technique.
5. Gun-perforating methods.
6. Design of completion tools.
7. Acidizing, shooting procedures.
8. Design of equipment installed.
9. Methods of inducing flow.
10. Advance planning of all well completions.

● **"Savings" on completions is false economy.** Some operators are content to complete their wells without much regard to the latest developments in completion equipment and technique and without adequate advance planning and preparation. Whether they realize it or not, they may pay dearly for this neglect in decreased production and increased costs during the entire life of their wells. The "saving" of a few hundred dollars during the completion of many wells is often followed by a series of expensive and hazardous workover jobs or other remedial practices that often fail to pay out.

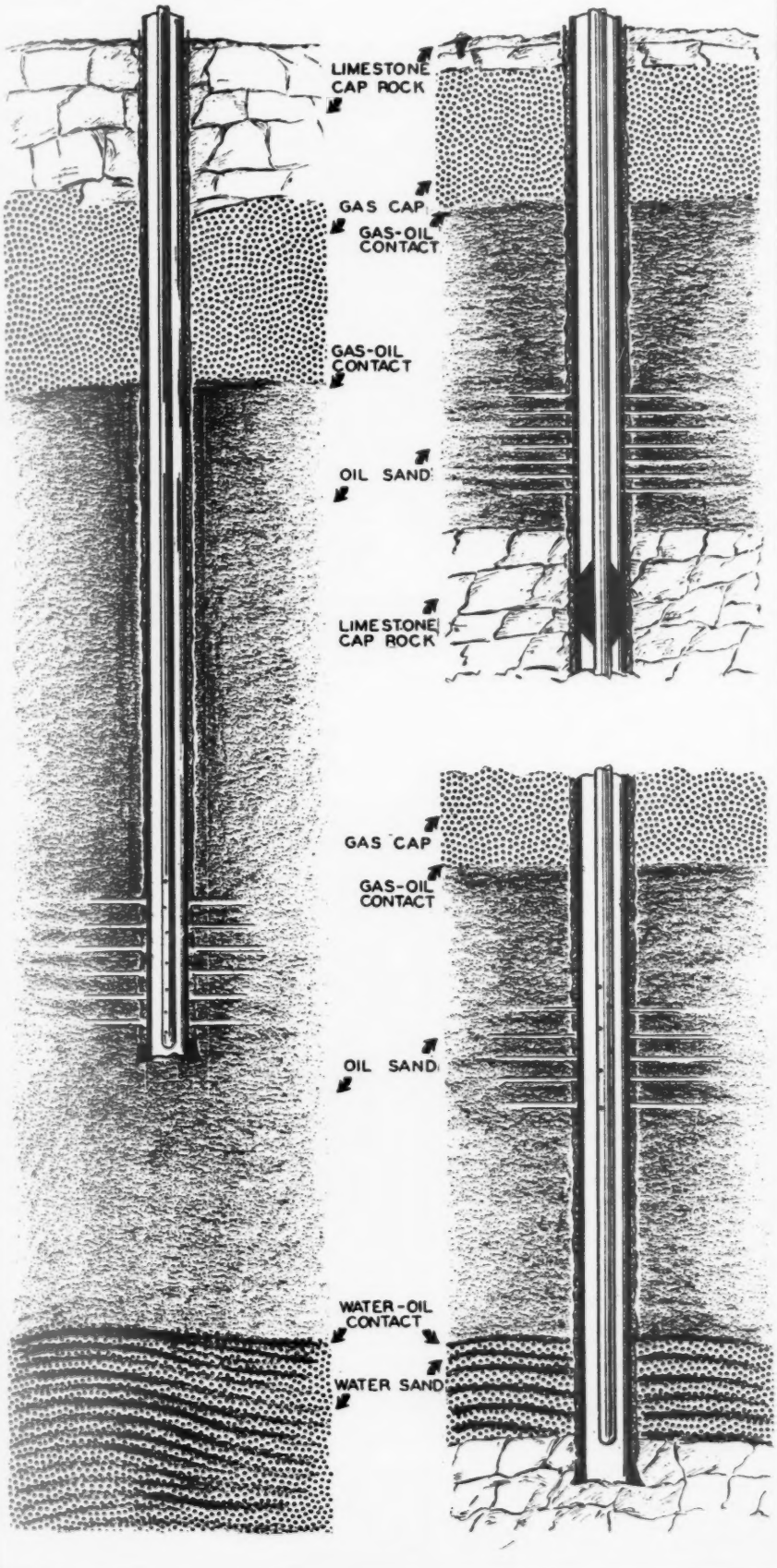
Other operators realize that important savings can be made during the life of a well by making the necessary expenditure for a proper well completion. By so doing the initial allowables are sometimes enough higher that the additional cost to these operators may be more than repaid in the first few months.

● **Wells sometimes improve after completion.** It is not uncommon for the production of a well to show a substantial increase many months after initial completion. In some cases, pumping wells or even temporarily abandoned wells have begun to flow. Such occurrences may and frequently do indicate that the initial completion method or the equipment installed in the well was faulty, improperly applied, or unsuited to the producing formation.

In other cases, the productivity index of flowing and pumping wells has gradually improved over a period of months after initial completion without any remedial work or changes in producing method. Such improvement likewise may indicate that the initial completion practices were unsuited or damaging to the producing formation. Water from the drilling mud or the mud itself might

FIG. 1. Cross-section of an oil well, showing perforated casing and tubing joint, completed in the central section of an oil sand found between a gas cap and water sand.

FIG. 2. Cross-section of an edge oil well completed dually from two sands: Upper sand produces through perforated casing—lower sand through perforated tubing.



have blocked the natural flow channels into the well bore, or the perforations, liners, or screens might not have been cleaned up when well was brought in.

In many other cases, however, the damage done to the producing formation by the initial completion practices is of a permanent nature, and attempts to do remedial work might result in additional damage.

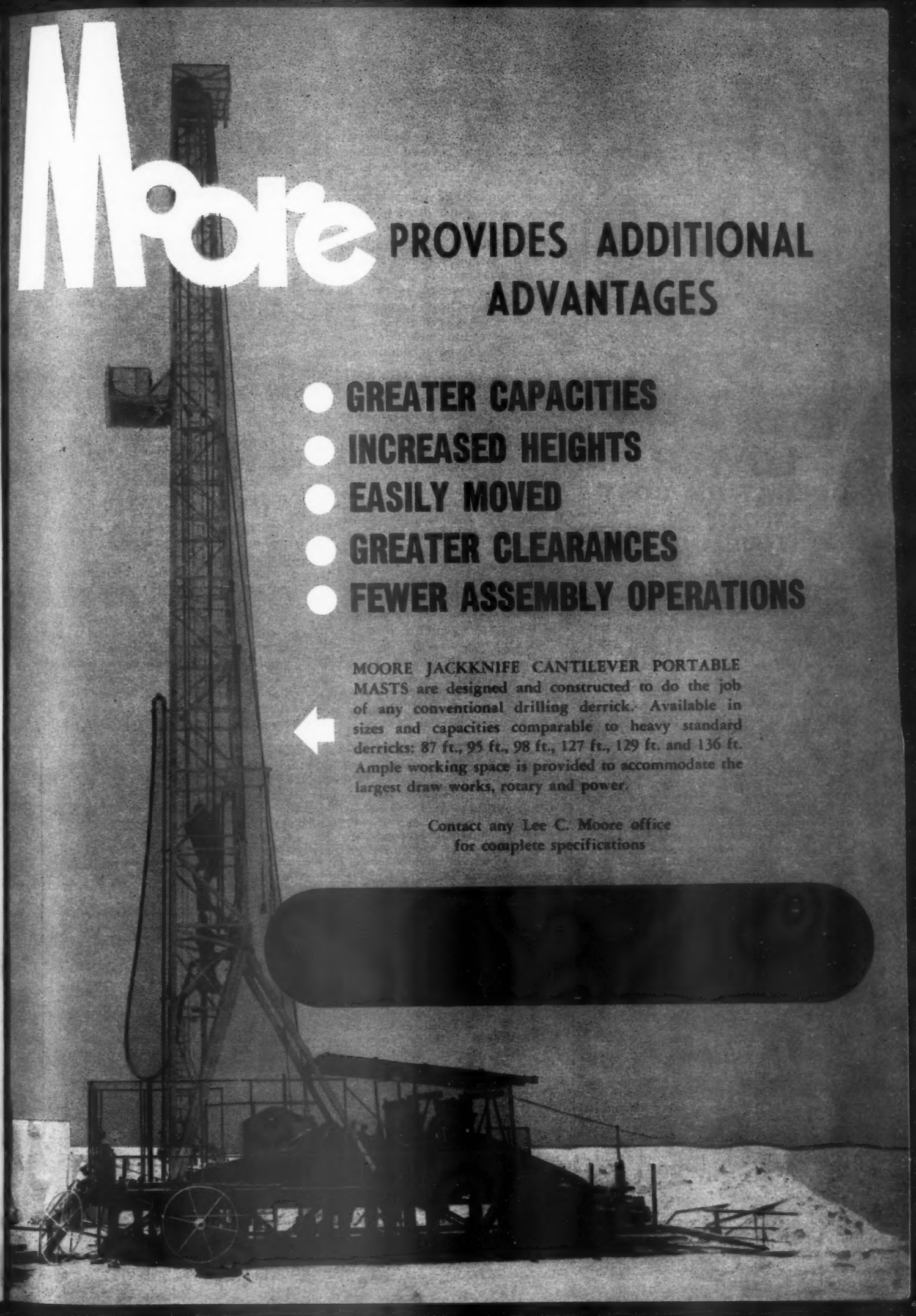
● **Examples of wells that improved.** The reader can probably recall instances in his experience where the production of a well improved after completion. Today's paper reports that an edge well in a field in Wood County, Texas, has just been recompleted with a flowing potential of 400 bbl per day on a ¼-in. choke with a pressure of 400 psi on the tubing. The well had been completed initially a few months ago as a small pumper in the Paluxy formation at 6300 ft. The flow began as tools were being run to clean out the well. The tools were hurriedly pulled and the flow was turned into the tanks. Recompletion as a flowing well indicates plainly that something was wrong or mistakes were made in the completion method used originally.

A well was drilled in a field in the Gulf Coast into a 20 ft section of Frio sand. Pipe was set and completion attempted without success. The hole was plugged and abandoned. About a year later another operator recompleted the same well with an initial flowing potential of 500 bbl on a small choke. Obviously, something was far wrong with the first completion attempt.

A well in a field in Sumner County, Kansas, was completed as a small pumper from the Simpson sand at 4400 ft. Without any changes in producing practice or remedial work, the productivity index of this well increased appreciably as determined by periodic fluid level tests during the first 5 years of its producing life. Improvements in production such as these just cited are sometimes explained by the statement: "The well drilled itself in." Unfortunately, many wells are damaged permanently by poor completion practice and never drill themselves in.

● **Reasons for planning well completions.** Drilling conditions and natural physical factors in the producing formations are so variable from one area to another, from field to field in the same area, and even from well to well, that no one set of completion rules will apply. The well completion practices listed in Table 2, however, have helped operators obtain higher initial production in many fields, especially where the producing formations have low permeability and normal or low reservoir pressure.

The practices listed in Table 3 are the ones that often damage wells in any field, and yet some of these practices must be used: To prevent the wells from blowing out (1, 3, 7, 11), to complete a producing well in a thin sand (2, 9), to continue drilling to a deeper producing formation (1, 2, 3, 5), to tell whether an indicated producing formation is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worth a string of casing (8), and to obtain an economic rate of production (2, 6, 9, 10).

Whenever any of the practices listed in Table 3 must be used or allowed to prevail during the completion period, the operator should bear in mind the possible physical damage that might occur to the well and the detrimental effect on the initial production.

The classification of the practices into the two categories provides operators with a ready guide to good completion practices and practices to avoid or use with caution. Advance preparation and planning for well completions will enable operators to complete more profitable wells by avoiding conditions listed in Table 3.

● **Water from mud can block off production.** When the drill reaches the cap rock above the producing formation, an operator must be prepared to carry out each step in a carefully planned completion program as quickly as possible, for any lengthy delays in bringing in the well after the producing formation is drilled can damage or ruin a well's productivity. This is especially true of wells that are completed with heavy water-base mud in producing formations having low permeability, bentonitic or heaving shales, or fine-grained silty sands.

● **Many alternatives in selection of a plan.** The operator's problems in planning the completion of a well are briefly as follows:

1. To decide when and how the producing formation is to be penetrated, that is, will casing be set in or near the top of the producing formation before or after drilling to total depth, and will the producing formation be cored or drilled.

2. To decide the type and physical characteristics of the drilling fluid that will be used in making the penetration, and whether the producing formation will be treated with acid or will be shot prior to installation of producing equipment.

3. To decide the design of the subsurface equipment that will be left in the well and the methods that will be used to bring the well in and keep it producing.

● **Allowance for changes in plan.** It is obviously impossible in all cases to predict the exact nature, thickness, and position of the producing formation, but a prudent operator is prepared to alter his completion program, so as to obtain the highest initial productivity rating. In the case of oil wells, there must be an adequate shut-off of gas production from the top of the producing formation. An adequate distance also must be kept between the total depth of the well and the water-oil contact in the bottom of the producing formation.

An adequate distance also must be kept between the total depth of the well and the water-oil contact in the bottom of the producing formation.

The faster a producing formation can be penetrated and the well completed, the higher the initial productivity, and the greater the ultimate recovery provided (1) that the formation is not water blocked or mudded off, and (2) that the producing formation is connected to the well bore with the least possible restriction. In the case of oil wells, however, the connection should be designed to seal off gas and water production in-

TABLE 2. Well completion practices and conditions that tend to increase the initial production.

1. Drilling in with oil, oil base, or a light weight, low water loss drilling fluid.
2. Exercising care to bottom the well a safe distance above the water-oil contact.
3. Setting casing or blank liner through the gas cap and cementing adequately without cementing off the oil producing section.
4. Connecting the maximum thickness of producing formation with the well bore by perforating, acid treating, shooting, and by other means that are consistent with safety from excess free gas production or bottom water coning.
5. Bringing in the well, if possible, by displacing the drilling fluid with light crude oil or casinghead gasoline.
6. Protecting the producing section from water blocking, mudding off, or sloughing during the periods in the completion procedure when it is exposed to fluids in the well bore.
7. Reducing the number of hours that the producing section is exposed before the well is finally completed.

TABLE 3. Well completion practices and conditions that tend to reduce the initial production.

1. Drilling in with excessively heavy drilling muds.
2. Drilling too close to or into a bottom water producing section.
3. Drilling in with high mud pump pressure and excessive volumes of drilling fluid.
4. Exposing low permeability or bentonitic producing sections to infiltration of fresh water, or high water loss mud made with fresh water.
5. Leaving producing section open to infiltration from a heavy column of drilling fluid for an excessive number of hours.
6. Using an excessive amount of acid, chemicals, or other materials to stimulate flow.
7. Failure to clean out mud cake, cavings, cement, or other plugging agents before setting liners and running tubing.
8. Drill stem testing some soft formations.
9. Casing the well too high or leaving open too much of the oil producing section between the gas cap and bottom water.
10. Gun-perforating too much of the producing section.
11. Not gun-perforating sufficiently the right part of the producing formation or not spacing the shots as advantageously as possible.
12. Producing well at excessively high rate during the drilling in and completion period.

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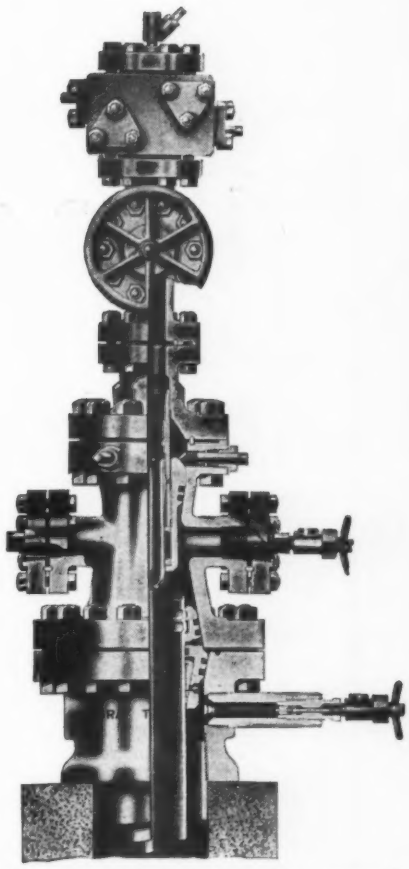

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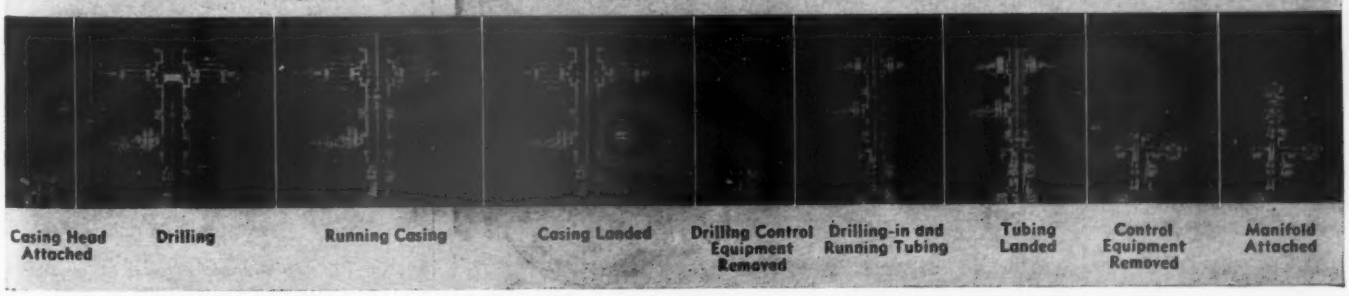

itially, and for as long a time as possible in the life of the well. Final completion plans cannot be made in advance for wildcat wells, semi-wildcat wells on the edges of producing fields, and dual wells in some multi-zone fields. Tentative completion plans can be made, however, and, by the use of precautionary practices and controlled conditions, such as low water loss drilling mud, the potential producing formations can be protected while drilling and testing proceeds.

● **Single and dual completions.** A well completed in one producing formation is called a single completion, and a well completed in two producing formations is known as a dual completion. Figs. 1 and 2 are examples of such completions. A brief description of the way the single well of Fig. 1 was completed is as follows:

1. Drilling was stopped at a point in the cap rock a few feet above the top of the gas cap. Preparation was made to run electric log and case the hole. Water-base drilling mud was displaced with crude oil for drilling in, due to relatively low pressure and known low permeability and bentonitic nature of the pay. Also, it was desired to core to determine connate water.

2. Core bit was run to the predetermined total depth—calculated to be a safe distance above the known water-oil contact level.

3. The electric log was run as soon as the drill pipe was pulled. Preparation was made to have cementing equipment ready.

4. Casing with shoe was run to total depth and cemented.

5. Casing was tested after cement had set 36 hours. Casinghead connections were made and preparations made to bring in the well. Gun-perforator was run and the casing perforated with enough shots per ft to provide a high productivity index, but the perforations were concentrated in the central part of the sand to prevent premature water encroachment or free gas production.

6. The tubing with a perforated joint was run and the christmas tree was connected.

7. The well began to flow after a few pulls with a swab brought in some "live" oil, that is, oil containing solution gas.

● **Steps in making a dual completion.** The dual completion of Fig. 2 was completed somewhat differently from that of the single completion:

1. Drilling was stopped in the cap rock above the first producing formation while the drilling mud was checked for weight, water-loss, and API viscosity. Preparations were made to drill both producing formations as the pressures were normal for depth and the average permeability was known to be about 500 md.

2. Although the producing formations were about 800 ft apart, the well was drilled to the predetermined total depth in 48 hours.

3. Electric log was run after pulling drill pipe.

4. Casing was run to total depth and cemented.

5. Gun-perforations were made as indicated in Fig. 2 after casing was tested.

6. Tubing with perforated joint and packer was run. Packer was set between producing formations as indicated to separate the tubing from the tubing-casing annulus, or "casing."

7. The well head connections were made, and the well was "washed in" by displacing the drilling mud in the casing and tubing with oil. Both producing formations should flow clean oil for many years, because of the attention paid to seeing that the perforations were placed in accordance with the permeability profile and in the most strategic part of the sections with respect to gas cap and bottom water drives.

References.

1. "Bottom-Hole Well-Completion Methods in the Gulf Coast," I. W. Alcorn and J. U. Teague, Drilling and Production Practice (API) 1937, pg. 30.
2. "Reconditioning Procedure With Portable Equipment," Henry E. Winter, Drilling and Production Practice (API) 1937, pg. 202.
3. "Completion Practices Related to Well Productivity," W. J. Travers, Jr., T. P. No. 1465, AIME Petroleum Technology, March 1942.
4. "Oil Base Drilling Fluids," Geo. Miller, AIME paper, New York meeting, March 17-22, 1947.
5. "Hard Rock Drilling in the Permian Basin," David Johnston, API paper, Fort Worth meeting, March 27-28, 1947.
6. "Gun Perforation Designs for Uniform Productivity," Warren J. Jackson, *The Petroleum Engineer*, March, 1947, pg. 113.

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Fig. 247
Acme Trip Casing Spear

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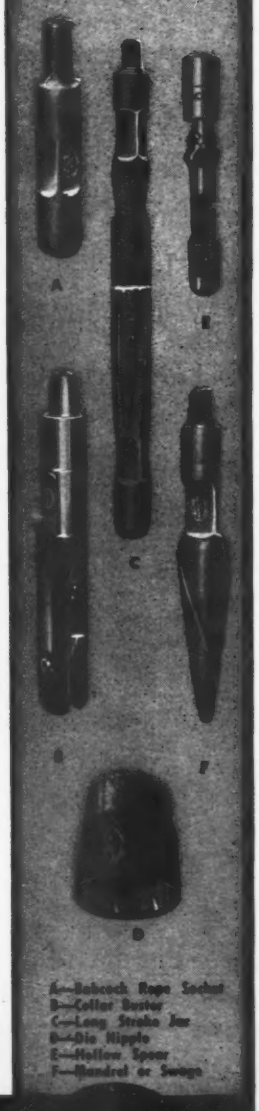

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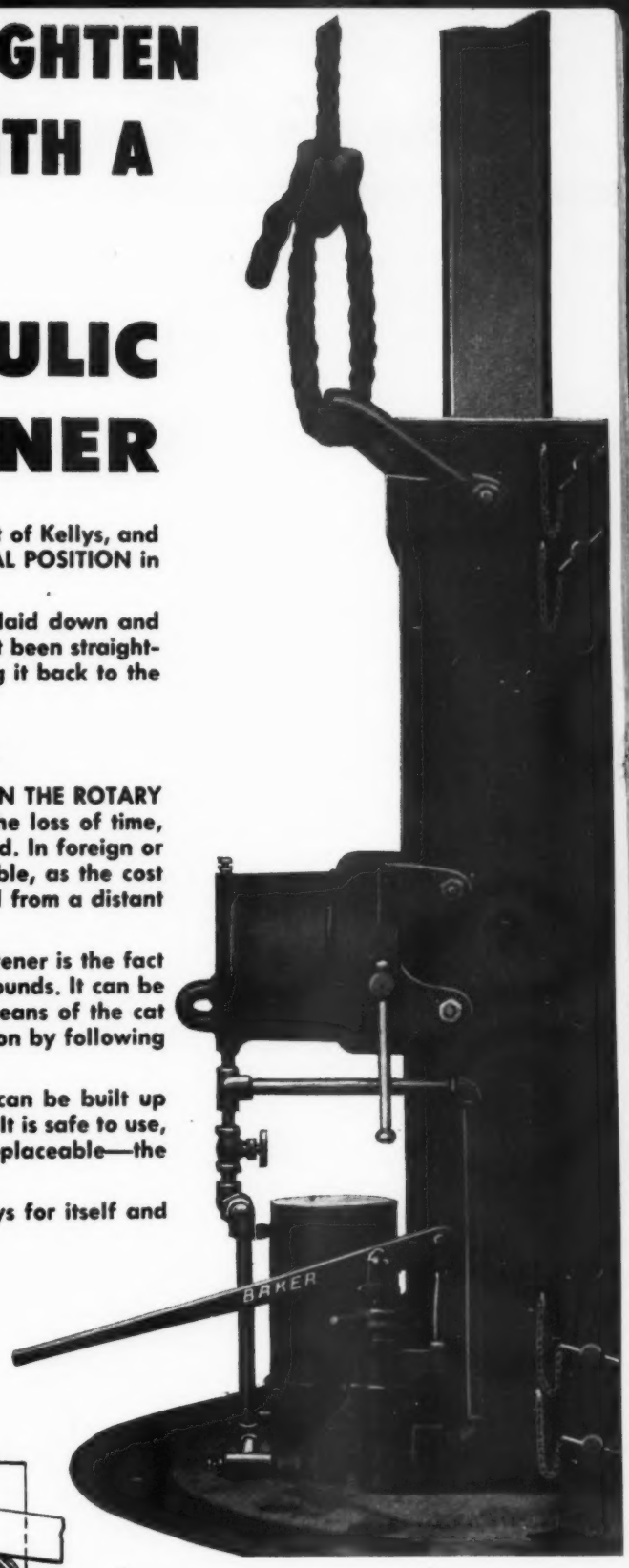

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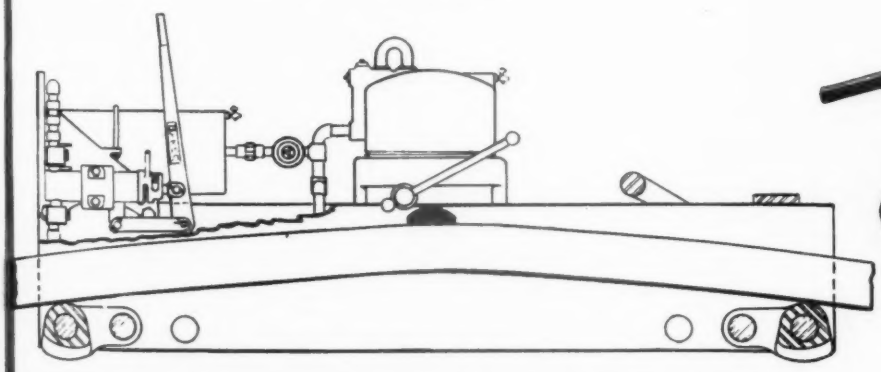

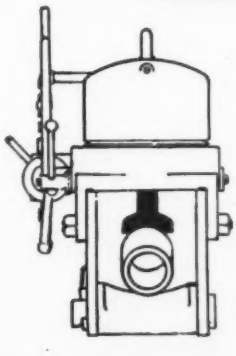

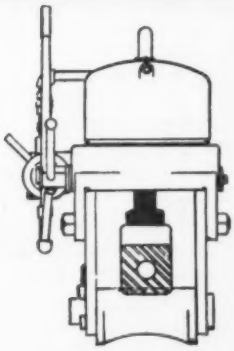

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• **W. F. Bramstedt** has been elected vice president in charge of crude oil sales of California Texas Oil Company, Ltd. Caltex is a joint enterprise of Standard Oil of California and The Texas Company. Bramstedt took his degree in mechanical engineering at the University of California. For the last 20 years, he has been connected with the engineering, refining, and crude oil divisions of the oil industry. During the war years he was in White Horse, Yukon Territory, project manager in the field for the operation and maintenance of the United States War Department's Canol Refinery and pipe line system. Bramstedt joins Caltex from the Arabian American Oil Company.

• **M. I. Signer,** head of the department of mining, has been named dean of the faculty of the Colorado School of Mines, Golden, Colorado, effective April 1. He succeeds **James Boyd,** recently nominated by President Truman for the position of director of the U. S. Bureau of Mines.

Dean Signer is well known in mining and other mineral engineering circles. He has been head of the department of mining engineering at the School of Mines since 1943, and since 1929 has been a member of the faculty of that department.

• **C. C. Hogg,** former oil man and now director of the Edwy R. Brown School of Petroleum at Marietta, Ohio, College, has been appointed by the Hon. Thomas J. Herbert, governor of Ohio, to serve on the research and coordinating committee of the Interstate Oil Compact Commission.

Hogg is a director and former general manager of the Patoil Corporation, Pleasantville, Pennsylvania. He has also served as vice president and general manager of the National Petroleum Company. He assumed the directorship of the Brown School of Petroleum last spring.

• **C. H. Boles** has been appointed manager of the Sundown, Texas, store, of the Continental Supply Company, succeeding **V. H. von der Lin.** The latter has been named field salesman at Odessa, Texas. **Lloyd Viator** is now manager of the company's New Iberia, Louisiana, store. He succeeds **E. S. Snyder** who has resigned.

• **C. E. Ridley,** formerly chief clerk in the Lindsay, Oklahoma, store of Bethlehem Supply, has been promoted to field representative in the Lindsay area. **J. J. C. LeFlore,** formerly floorman at Seminole, Oklahoma, and more recently at Lindsay, has been advanced to assistant store manager at Lindsay.

• **Ken W. Davis,** president of the Mid-Continent Supply Company, Fort Worth, Texas, has been appointed a director of the First National Bank of Fort Worth.

• **John M. Bastion** has been appointed Goodyear Tire and Rubber Export Company's sales representative, with headquarters in San Francisco. Bastion will be in charge of the company's complete line of export items, including tires, tubes, mechanical goods, chemical, and shoe products.

A native of Vinton, Louisiana, Bastion is a mechanical engineering graduate of Texas A. & M. College. He joined Goodyear in 1938 on the company's production training squadron. Early in the war he became a gas mask engineer for Goodyear, but later joined the army air force and achieved the rank of captain as a bomber pilot. He made 30 combat missions and received the Distinguished Flying Cross and the Air Medal with three clusters. Since his return from military service Bastion has been associated with Goodyear Tire and Rubber Export Company's mechanical goods department in Akron.

• **John A. Bolt** has been appointed assistant superintendent of technical service in the research department of Standard Oil Company (Indiana). Bolt joined the company in 1930 as a chemist in the research laboratories at the Whiting, Indiana, refinery and since 1944 has been a group leader. He did his undergraduate work at Calvin College, Grand Rapids, Michigan, and received his master of science degree in chemistry from the University of Michigan.

Four group leaders have also been appointed in Standard's research department. They are **David W. Bransky, D. E. Bruce, T. B. Tom,** and **Lindsay M. Hobbs.**

John E. Swearingen, group leader in the research department at Whiting, was transferred April 1 to the Stanolind Oil and Gas Company at Tulsa, Oklahoma, succeeding **Carl W. Peters.**

• **Henry Rowold** has been appointed assistant general sales manager of Mack International Motor Truck Corporation. Rowold, a vice president of the company, combines his new duties with those of national accounts manager, a position he has held for some time.

• **Walter S. Hallanan,** chairman of the National Petroleum Council, announces the appointment of **James V. Brown** of Washington, D. C., formerly of Bradford, Pennsylvania, as secretary-treasurer of the council effective April 1. Brown has been identified with the oil industry for almost 20 years and has had a very extensive background of experience as secretary of the Petroleum Industry War Council's production committee and subcommittee on petroleum economics, and as vice chairman of the economics advisory committee of the Interstate Oil Compact Commission. For several years, he has been connected with the Independent Petroleum Association of America as a statistician and analyst.

• **William V. Burger** has been appointed registrar and director of admissions at the Colorado School of Mines, Golden, Colorado. Burger assumed his new duties March 17. Since May 1942 he has been in military service with duties as personnel officer and counselor both in the United States and overseas. Previous to his military service, he was director of admissions at Coe College, Cedar Rapids, Iowa, from 1936 to 1942, and admissions counselor at Lawrence College, Appleton, Wisconsin, from 1934 to 1936.

• **Walter A. Haas,** president of Levi Strauss and Company, San Francisco, and an officer and director of various real estate and financial organizations in California, has been elected a member of the board of directors of Tide Water Associated Oil Company.

• **Dr. Theodore W. Evans** has been appointed manager of the Emeryville, California, research laboratories of Shell Development Company. He succeeds Walter J. Hund who died February 17. Dr. Evans joined the Emeryville staff in 1930 as a research chemist and was active in the early development of alcohols, ethers, and esters from refinery cracked gases and in the development of the solvent extraction theory.

T. W. Evans

Long before the war Dr. Evans was pioneering in the development of synthetic glycerin from petroleum. During the critical rubber shortage his studies led to early supplies of vital synthetic rubber by an exclusive Shell process. By 1941 he was supervising all exploratory studies on new chemicals as well as research on their application in such fields as surface coating and resins. He was appointed an associate director of research in 1942.

• **Robert L. Miller,** formerly assistant sales manager of the road machinery division of The Heil Company, Milwaukee, Wisconsin, has been appointed district sales manager for all Heil products in the central states of Iowa, Missouri, Nebraska, Kansas, and Colorado, with headquarters at Kansas City.

• **E. A. Schiele** has been appointed representative of the Steel Improvement and Forge Company in the Chicago area. Schiele formerly was with the Graver Tank and Manufacturing Corporation and prior to that time with Johns-Manville and the Central Scientific Company. He attended the University of Illinois, Northwestern University, and Illinois Institute of Technology. His office is at 1747 McCormick Building, Chicago.

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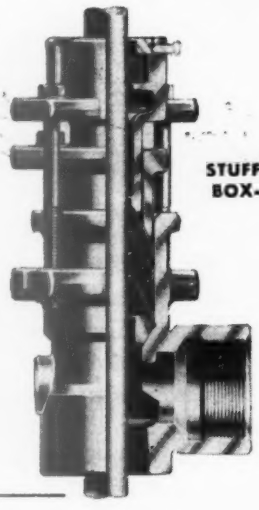

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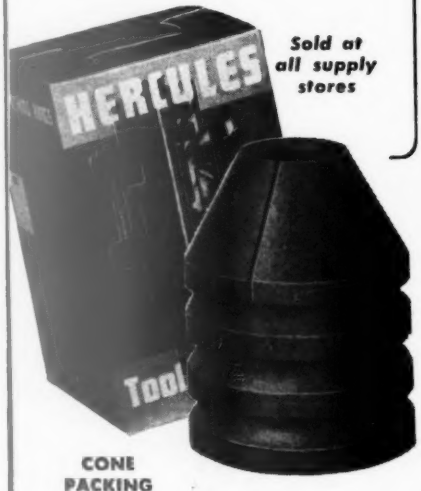

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EXPORT OFFICE: 30 Rockefeller Plaza
NEW YORK, U.S.A.
CABLE ADDRESS: HERTOCO

• **Alexander Deussen,** consulting geologist of Houston, Texas, received the Sidney Powers Memorial Medal Award of the American Association of Petroleum Geologists. This high honor is bestowed "in recognition of distinguished and outstanding contributions to, or achievements in, petroleum geology." Association president Earl B. Noble, chairman of the medal award committee, presided at the brief ceremony at the Biltmore Hotel, Los Angeles, during the 32nd annual meeting of the AAPG. Wallace E. Pratt, formerly a director of the Standard Oil Company (New Jersey), and recipient of the award in 1945, delivered a biographical appreciation of Deussen.

Deussen is a pioneer in the use of new methods and instruments in oil finding. His early work, in 1911, on underground water resources, made for the U. S. Geological Survey, laid reliable groundwork for present knowledge of the structure of oil-bearing formations in Coastal Texas. He suggested the control of oil accumulation by faulting in the Mexia-Powell fault zone of East Texas. One of his many Government publications, "Geology of the Coastal Plain of Texas," published in 1924, has been an indispensable guide to young geologists for two generations.

• **R. R. Robison** has been made division superintendent, San Joaquin Division, Shell Oil Company, Inc., Robison has been with the company since 1924, and prior to his promotion was division drilling foreman in the Rocky Mountain area.

• **D. U. Skinner,** the Houston Oil Field Material Company's South American representative, has recently returned to the United States. He will remain in the States for approximately six weeks and will then return to his headquarters in Caracas, Venezuela. Skinner has been aiding in sales work and serving as an experienced consultant for cutting and fishing tool problems in Central and South America for the last six months.

• **Fred S. Crook** has been appointed district engineer for Elgin Softener Corporation, Elgin, Illinois, in the St. Louis territory. The territory includes eastern Missouri, southern Illinois, and western Kentucky. Crook will retain the present St. Louis headquarters in the Paul Brown Building. He will be in charge of sales engineering activities for the company's line of water softeners and filters, water treatment chemicals and chemical feeders, and boiler water conditioning systems.

• **M. L. (Jack) Cunningham** has recently joined the staff of Standco Brake Lining Company, Houston, Texas, bringing with him 19 years' experience as drilling and cementing engineer with Gulf Oil, Humble, Halliburton, Dowell, and others. C. W. Hanslip, president of Standco, has announced that Jack will coordinate Stanco sales and service between supply houses, drilling contractors, and rigs. "Other duties of the job," Hanslip said, "include trouble-shooting and keeping in touch with new developments and new problems in the field."

• **H. W. Ladd,** Stanolind Oil and Gas Company, Tulsa, Oklahoma, addressed the Oklahoma Society of Petroleum Engineers at Oklahoma City on March 19, on "The Selection of Casing for Oil Wells." **Don Knowlton,** Knowlton Engineering Company, addressed the same organization recently on "The Problems of Unitization."

• **Martin G. Levens** has been appointed Cleveland, Ohio, sales representative for the Columbia Chemical Division of Pittsburgh Plate Glass Company. After his graduation from Gettysburg College in 1941, Levens joined the Atlas Powder Company as acid and powder line supervisor and later served as chief chemist. Called to active service with the U. S. Naval Reserve in 1944, he served as a lieutenant aboard an LST in the Atlantic and Mediterranean areas. Since his release to inactive duty last July, Levens has been associated with Columbia Chemical's sales department.

• **George L. Tyler** has resigned as secretary-treasurer of California Natural Gasoline Association to join the Petroleum Chemicals Division of E. I. Du Pont de Nemours and Company, Inc. He will be assigned to the Los Angeles district after a short period in the company's Wilmington office. Tyler left CNGA April 1 after nine years with the association, during which time the group has enjoyed steady growth in membership and has received wide recognition for the work it is doing in its particular field.

• **Henry Ronald Voelker** has been recently appointed representative in the Indianapolis area of the Steel Improvement and Forge Company. Voelker has been a manufacturers' agent since 1938 and prior to that served as district manager of the Rotor Air Tool Company, sales representative of the Ingersoll-Rand Company, and was connected with the Pennsylvania Railroad Company for 15 years.

• **Walter S. Parker,** night superintendent of the light oils division at the Whiting refinery of Standard Oil Company (Indiana), has retired on company annuity. **Paul Dobbertin,** shift foreman in the crude still department of the light oils division, succeeds him.

Parker is one of six brothers who together have accumulated 253 years of service at the Whiting refinery. James T. Parker was office supervisor in the construction department when he retired in 1944 after 53 years' service. The other brothers, who are still working, and their years of service are George J., foreman in filtering oils, 41 years; Charles P., treater in light oils, 39 years; William, gas engineer in light oils, 34 years; and Oby, boilermaker, 31 years.

• **H. B. Gilmore,** field representative in the Artesia, New Mexico, area, has been appointed store manager and field representative at the Artesia store of the Bethlehem Supply Company to succeed **F. E. Smith. W. B. House,** field representative at Houston, Texas, has been transferred to Eunice, Louisiana, as field representative in that area.

• **Paul D. Barton** has been made chief engineer of the manufacturing department of Sun Oil Company, it has been announced by Clarence H. Thayer, vice-president in charge of manufacturing.

Paul D. Barton

Barton, formerly assistant manager of the engineering division, joined the company in 1934 and has been responsible for the design of all light hydrocarbon recovery and fractionation plants constructed since that time at the company's refineries. Among other large-scale projects he supervised both the chemical engineering and physical design of the hydrogen fluoride alkylation plant built at Sun's Marcus Hook, Pennsylvania, refinery in 1943, and the solvent refined lubricating plant completed in 1944. The alkylation plant is the largest single plant of its type in the world.

In his new post he succeeds Thayer, who was elected a vice president on March 18.

• **W. T. Stratton** has been appointed director of purchases of the Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corporation, and will have his headquarters at the Curtiss Building, 361 Delaware Avenue, Buffalo, New York. Stratton will replace **E. A. Johnston,** who has resigned. Stratton brings to his new association a total of 28 years in the purchasing and traffic departments of the steel industry. He began with the United Alloy Steel Corporation in Canton, Ohio, in 1916. In 1929 the United Alloy Steel Corporation merged with the Republic Steel Corporation and he continued in the employ of the Republic Steel Corporation until 1944 when he joined the Valley Camp Coal Company as district manager at Cincinnati, Ohio.

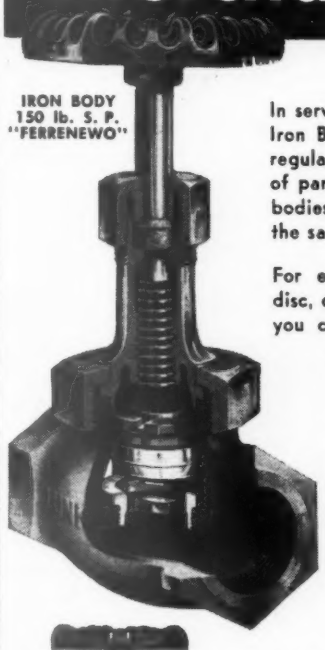
• **Ellis L. Spray,** vice president of the Westinghouse Electric Corporation, has announced the appointment of **Gerald Z. Wollam** as his assistant in the supervision of the company's elevator division in Jersey City, New Jersey, and the Sturtevant Division at Hyde Park, Massachusetts. Before assuming his present assignment Wollam was director of the company's wage incentive department and chairman of the wage procedure coordinating committee in Pittsburgh, since July, 1944.

• **F. D. Thomas,** veteran of 18 years with General Petroleum Corporation and a prominent member of that concern's comptroller's staff, has been named special assistant to the comptroller of the the Socony-Vacuum Oil Company of Venezuela at Caracas, it is announced at G. P.'s home office in Los Angeles. Thomas left March 17 to assume his new position.

REPAIRS SPEEDED
DOWNTIME REDUCED
COSTS CUT . . .

by LUNKENHEIMER
Interchangeable Parts

IRON BODY
150 lb. S. P.
"FERRENEWO"

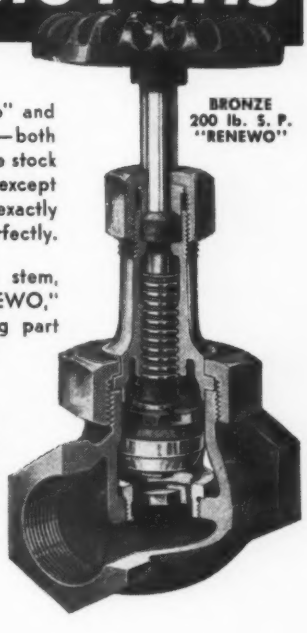


In servicing the Bronze "Renewo" and Iron Body "Ferrenewo" Valves—both regular and plug types—only one stock of parts is required. All parts (except bodies and bonnet rings) are exactly the same and fit each other perfectly.

For example—if you need a stem, disc, or seat ring for the "RENEWO," you can use the corresponding part of the "FERRENEWO," and vice versa.

Repairs are more quickly and easily made, ordering and handling are simplified. The result: Lower maintenance cost and low ultimate valve cost.

BRONZE
200 lb. S. P.
"RENEWO"



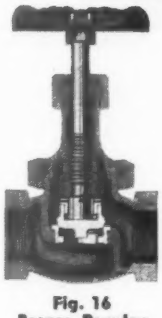


Fig. 16
Bronze Regular
"RENEWO"

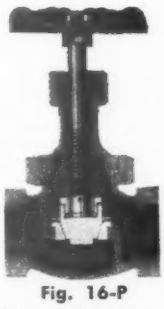


Fig. 16-P
Bronze Plug Type
"RENEWO"

Lunkenheimer part-interchangeability is fully illustrated and described in Circular No. 567.

Ask your Lunkenheimer Distributor for a copy, or write direct.

VALVE MAINTENANCE SIMPLIFIED!

There are fewer parts to be carried, repairs are more quickly and easily made. The labor, time, and expense of valve maintenance is cut down—'way down!

SAVE THIS WAY, TOO!

For severe throttling service, a regular type can be converted into a plug type, by simply changing the seat and disc, without taking the valve out of the line.

Thus it's not necessary to buy a whole new valve—just a matched set of plug type seat and disc which interchange perfectly in corresponding patterns and sizes in a range of pressures from 150 to 350 lb. S. P.

Lunkenheimer simplicity of design, minimum number of parts, and fine precision workmanship make this and other outstanding economies possible.

SEE YOUR LUNKENHEIMER DISTRIBUTOR!

Lunkenheimer Distributors are located in all industrial centers. There is one near you—have him demonstrate with actual samples the interchangeability of parts in "RENEWO" and "FERRENEWO" Valves. It's a big time and money saver for any plant!

THE LUNKENHEIMER CO., Cincinnati 14, Ohio
(OFFICES: NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7.
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To back up its "length of service" guarantee, Thermoid has to be sure that strength is there. That's why special machines precision wrap the reinforcing cables. That's why oil and weather resistant neoprene is used throughout. That's the reason for the exclusive patented method of joining coupling and hose. That's why every length is tested to 5,000 lbs. before shipment, and, at regular intervals, a production sample is burst-tested to 11,000 lbs.

Based on year after year endurance records, Thermoid Powerflex Rotary Hose actually costs less for each foot of hole! This is another example of the best product costing less in the long run.

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Our Oil Field Warehouses can ship NOW

Your supply store probably carries Powerflex Rotary Hose. If not—the home office will furnish the names of local distributors upon your request.

Thermoid OIL FIELD PRODUCTS BUILT FOR THE JOB QUALITY VALUE SERVICE

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THE THERMOID LINE INCLUDES: ROTARY BRAKE BLOCKS • WOVEN OIL FIELD BRAKE LINING • PACKINGS • ROTARY HOSE • SLUSH PUMP HOSE • FLEXIBLE DISCHARGE UNIT HOSE • PRODUCTION AND REFINERY HOSE OF ALL TYPES • V-BELTS AND DRIVES • OIL COUNTRY BELTING • STUFFING BOX RINGS • "NO WIP" LINE SAVER • WIRE LINE TURN BACK

Ralph Haddox advanced

Appointment of Ralph Haddox, of Charleston, West Virginia, as assistant manager of the tubular department of Oil Well Supply Company is announced by Lloyd E. Tracy, vice president and general manager of sales of this United States Steel subsidiary.

Ralph Haddox

Haddox has been president and general manager of the United Pipe and Supply Corporation of Charleston. In his new position, he will be active in the country-wide sale of tubular products.

Departments consolidated

Consolidation of the FWD sales promotion department and advertising department under the managership of M. O. Stockland, Jr., is announced by The Four Wheel Drive Auto Company, Clintonville, Wisconsin. Stockland has served as sales promotion manager since the organization of that department early in 1946.

M. O. Stockland, Jr.

The consolidation move came as a result of the retirement of Francis M. Higgins as advertising manager in order that he might devote his time to his work as president of the Wisconsin Central Airlines.

Stockland has been connected with The Four Wheel Drive Auto Company since 1922 and has been at the home office in Clintonville since 1936.

S. C. Kyle succumbs

His numerous friends were saddened to learn that S. Clyde Kyle of The Pelton Water Wheel Company, died suddenly in Bakersfield, California, recently.

Kyle was best known in the oil fields for his part in the development and introduction of the Pelton Jack, used for hydraulic pumping of oil wells.

After spending the earlier years of his life in various endeavors, including a yacht-building business of his own in 1928 and 1929, Kyle had decided that he could design a successful hydraulic jack. In 1939 he took his ideas to The Pelton Water Wheel Company of San Francisco, which agreed to develop and market the product. From that time until 1945, he was engaged in development and refinement work with the Pelton engineering staff.

In 1946, he transferred to sales work, and it was on one of his sales trips to the Bakersfield area that he was stricken.

Assistant sales managers

Jones and Laughlin Supply Company, Tulsa, Oklahoma, announces the appointment, effective March 8, of H. L. Wilkins, Tulsa, and A. G. Bastian, Longview, Texas, as assistant sales managers. Wilkins was manager of branch stores.

A. G. Bastian, formerly general salesman in the East Texas district, will continue to make his headquarters in Longview.

H. L. Wilkins

A. G. Bastian

M. L. Eubank, Longview, Texas, formerly salesman for the East Texas district, has been made district sales manager for that district. W. O. Hardy, Tulsa city salesman, has been made district sales manager for the Kansas district, succeeding C. E. Robertson, resigned. Hardy will have his headquarters in Wichita, Kansas.

New Lufkin office

The Lufkin Foundry and Machine Company, Lufkin, Texas, announces the opening of its new office at 537 Commerce Exchange Building, Oklahoma City, Oklahoma, April 1. Cooper Richards, former manager of the Kansas area with offices at Great Bend, is in charge of the new Oklahoma office.

The new office will handle the sales and service of Lufkin equipment in the Oklahoma City and Kansas areas.

Linville E. Caraway, as sales engineer, and J. D. Bradley, as service engineer, will continue at Great Bend.

Heads Gardner-Denver

Edgar F. Schaefer, executive vice president of Gardner-Denver Company, was elected company president, and H. G. Myers, former president, became chairman of the executive board at the annual stockholders meeting held March 28 at Quincy, Illinois.

E. F. Schaefer

In assuming chairmanship of the executive committee, Myers takes the post formerly held by the late J. W. Gardner, and in this capacity will be actively associated with the affairs of the company. Mr. Myers joined the Gardner-Denver Company in 1927 as chief engineer.

Schaefer joined Gardner-Denver Company in July, 1919.

IT'S ON OR OFF IN . . .
JUST TWO TURNS!
WECO
DIZZY
thread
WING UNION
MAKE-UP FASTER
THAN ANY OTHER UNION
WECO Dizzy Thread Wing Unions came by their name honestly. Yes, this 6000-lb. test union makes up so fast it makes you dizzy! The original WECO design assures quick, positive engagement with the threads. The spherical male permits faster, perfect stabbing. It means maximum speed and safety with minimum effort on every hook-up. You can't buy a better union for your high pressure lines. Made in 1" size for Blowout Preventer hook-ups. Dizzy Thread Unions are one leading member of the most complete line of wing unions in the world. Yes, buy the best . . . buy WECO. Stocked by leading supply stores. Write for our latest catalog.
The Original
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WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment
WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
Houston 1, Texas
Export Representation:
CHIKSAN EXPORT COMPANY
New York 7 Brea, Calif. Houston 1

I.P.A.A. meeting

All producing areas of the nation will be represented at the mid-year meeting of the Independent Petroleum Association of America to be held in Jackson, Mississippi, May 8 and 9. Plans for the meeting are practically complete, it has been announced by association president B. A. Hardey, Shreveport, through executive manager C. E. Buchner, at national headquarters, Tulsa.

The two-day meeting will include addresses by nationally prominent speakers and will include reports of committees of the association engaged in making studies of particular industry problems. Selection of Jackson for the meeting recognizes the increasing importance of the southern states in the future development of the nation's oil reserves. Mississippi, Alabama, and Florida have become producing states within recent years and exploratory activity is widespread throughout these and other states of the southeast.

Recognized experts on petroleum industry affairs will address the meeting. The first session will be devoted to exploration, development, and geology of the southeastern area. Later sessions will consider problems of the independent domestic industry including the widely discussed proposals of trade agreements between 18 nations, the question of tideland ownership and whether or not the claim to these submerged areas is vested in the state or in the federal government. The question of imported oil as having direct influence on all phases of the domestic industry will also be thoroughly analyzed.

Vice president of the Independent Petroleum Association of America for the state of Mississippi, E. B. McGehee, Jackson, is chairman of the arrangements committee for the meeting. W. M. Vaughey, also of Jackson, and a member of the executive committee of the association, and local directors have advised that plans for the meeting are complete and that the final program will be announced shortly.

Sales representative

S. T. McCormick

The Vortox Company, Claremont, California, has announced the appointment of S. T. McCormick as sales representative for its line of oil-bath air cleaners and air-cleaning devices.

McCormick, who for a number of years was assistant to the chief engineer of the Hercules Motors Corporation, Canton, Ohio, will make his headquarters at the Chicago office of the Vortox Company, 2326 South Michigan Avenue.

Pacific Coast manager

Ken O. Hood is the new Pacific Coast district manager for the Falk Corporation, Milwaukee, it was announced recently by Walter Schneider, vice president in charge of sales. With headquarters in Los Angeles, he will direct Falk sales in California, Washington, Oregon, Nevada, New Mexico, Arizona, Colorado, Utah, Idaho, and parts of Wyoming.

K. W. Morrissey

K. O. Hood

Associated with the company for more than 10 years, Hood was on the sales staff in Detroit from 1936 to 1943 and most recently managed the Cincinnati district.

Returning to the Cincinnati post after an absence of four years, which he spent at the home office on special assignment during the war, is Kenneth W. Morrissey. Before becoming district manager of Cincinnati, he was in the Los Angeles and Pittsburgh sales district. He has been with Falk since 1928.

Parts for ★ ARMY ★ TRUCKS

New and Used

Largest Stock in America
6 x 6– 6 x 4– 4 x 4– 4 x 2

All Items Guaranteed

Fast Service

Phone ALpine 1711

★ Largest auto wrecking house in the west with most complete stock of new and reconditioned parts for all cars and trucks.

Pioneer Auto Wrecking Co.

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Earle Smith to Houston

Earle E. Smith has been appointed manager of sales in charge of National Tube Company's Houston, Texas, office, it is announced by H. J. Wallace, general manager of sales of this U. S. Steel subsidiary.

Smith was formerly manager of sales at the company's Tulsa, Oklahoma, sales office. He succeeds Forrest A. Marsh, who has been named assistant to the vice president in charge of sales at the company's headquarters in Pittsburgh.

Smith began working for the company as a machinist at McKeesport, after his graduation from Carnegie Institute of Technology with a degree in mechanical engineering. He held several engineering and operating positions at the plant until 1929, when he was made a field engineer in Texas. Three years later he became a sales agent at Tulsa, and later was transferred to Pittsburgh as director of service. He was appointed manager of sales at Tulsa four years ago.

E. E. Smith

G. F. Coons

Replacing Smith at Tulsa is G. F. Coons, who has been manager of National Tube's New Orleans, Louisiana, sales office since 1942. He is a native of Des Moines, Iowa, and was graduated from Wyoming State University, and was employed by several oil companies and the National Supply Company before joining National Tube as a field engineer in 1930.

Thomas W. Thorne succeeds Coons as manager of the New Orleans sales office. He was born in Littleton, North Carolina, and was graduated from North Carolina State College with a degree in mechanical engineering. He joined the company as a sales trainee, and has held positions as a salesman at Atlanta, Georgia, New Orleans, and Houston.

Service director

Frank E. Lobaugh, formerly technical service manager, has been appointed technical service director of the Lumnite Division, Universal Atlas Cement Company, United States Steel Corporation subsidiary.

Lobaugh attended the University of Pittsburgh and Alfred University, Alfred, New York, where he received a degree of ceramic engineer. From 1930 to 1940 he was assistant professor in ceramic engineering at Alfred University. In 1941 Lobaugh joined The Atlas Lumnite Cement Company, now the Lumnite Division of Universal Atlas, in the technical sales departments.

Regional managers

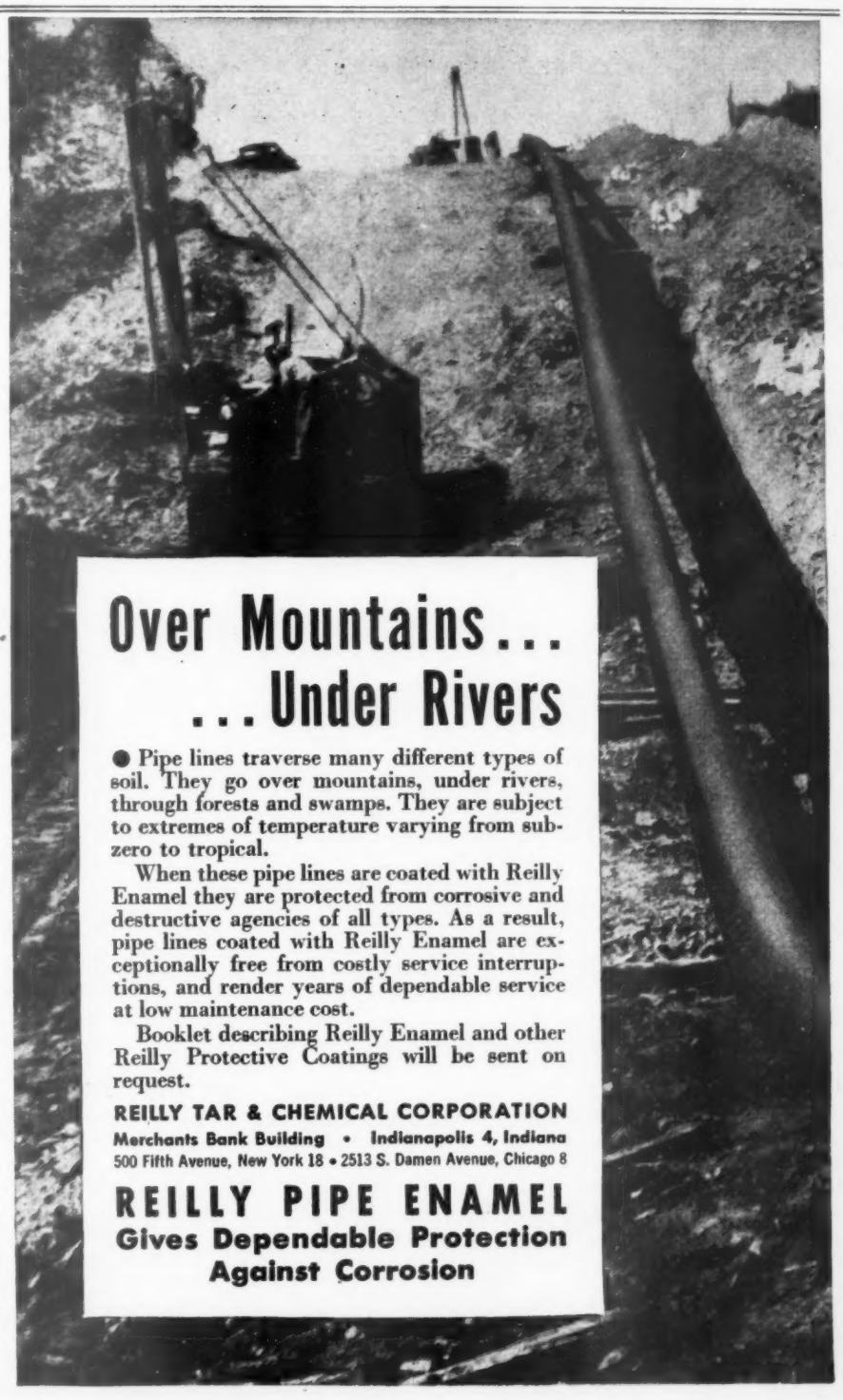
Appointment of two new regional managers, Walter N. Westland for the Eastern and George W. Stevens for the Mid-Continent regions, has been announced by L. W. Beck, general sales manager of the Cummins Engine Company, Inc., Columbus, Indiana.

Westland has been general sales manager of the Marion Power Shovel Company, Marion, Ohio, for the last three years. As manager of the Cummins Eastern region, his headquarters is at 6303 Chrysler Building, New York City, and his territory includes New York, New Jersey, Pennsylvania, Maryland, and the five New England States.

George W. Stevens, as manager of the Mid-Continent region of the Cummins Engine Company, Inc., has headquarters at 1812 Fair Building, Fort Worth, Texas. His territory covers the states of Texas, Oklahoma, and Louisiana.

Stevens formerly held the position of district manager of the National Supply Company, Superior Engine Division, in charge of oil field equipment sales in the Mid-Continent area.

Beck also has announced the appointment of Carmen Tenuta, former service manager of the Cummins Diesel Sales Corporation of Illinois, Chicago, as regional service representative in the company's Eastern region.


Over Mountains...
...Under Rivers
● Pipe lines traverse many different types of soil. They go over mountains, under rivers, through forests and swamps. They are subject to extremes of temperature varying from sub-zero to tropical.
When these pipe lines are coated with Reilly Enamel they are protected from corrosive and destructive agencies of all types. As a result, pipe lines coated with Reilly Enamel are exceptionally free from costly service interruptions, and render years of dependable service at low maintenance cost.
Booklet describing Reilly Enamel and other Reilly Protective Coatings will be sent on request.
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REILLY PIPE ENAMEL
Gives Dependable Protection
Against Corrosion

Personnel changes

W. E. Stiles

W. H. Davison, vice president and general manager, has recently announced changes in personnel and the redesignation of areas now being serviced in the United States by Core Laboratories, Inc.

W. E. Stiles, formerly district engineer of the North Texas district, has been transferred to Houston to serve as division manager of the newly formed Gulf Coast division covering Houston, New Orleans, Lafayette, Lake Charles, Beaumont, Corpus Christi, McAllen, Alice, and San Antonio.

Earl A. Nichols, formerly manager of Core Lab's reservoir fluid analysis department, has been advanced to Division manager of the Mid-Continent division, which includes North, East, and West Texas, Oklahoma, Northern Louisiana, Arkansas, Mississippi, Illinois, Indiana, Michigan, and New Mexico.

Rufe Bynum, formerly with the general office in Dallas, has been promoted to district engineer of the Central district. The Shreveport district has been renamed Ark-La-Tex and will continue under the supervision of Ralph W. Parnell, district engineer.

Rufe Bynum

Earl A. Nichols

Nelson W. Williams has been advanced from district engineer of the California district to manager of the Western division, which covers all operations in the Pacific and Rocky Mountain areas.

T. L. Kennerly, former assistant district engineer for the Illinois district, has been advanced to district engineer of the California district.

Exclusive distributor

Texasteel Manufacturing Company announces that exclusive distribution of its products in Oklahoma and Kansas will be handled by Texoma Supply Company. This line of products includes electric steel sucker rods, polished rods, and other sub-surface production accessories.

Texoma Supply Company is an old established oil-well supply concern with headquarters in the Elliott Building, 120 East Ninth Street, Tulsa 5, Oklahoma.

Special representative

J. A. Bynum, who has been district sales manager for Reading-Pratt and Cady Division of American Chain and Cable Company, Inc., in the southwest for many years, has been appointed special representative on Reading-Pratt and Cady valves for the pertroleum industry in that area.

J. J. Reed has been appointed district sales manager to succeed Bynum. For most of the last five years Reed has been at the factory in Reading, Pennsylvania. Prior to that he was engaged in sales work in the southwest so that with his new appointment he returns to the scene of his former activities. Both Bynum and Reed will make their headquarters at the Houston office of the company at 630 McFarland Street.

Attends meeting

George Miller, president of Oil Base, Inc., Los Angeles, attended the recent A.I.M.E. annual meeting in New York City where he presented a paper on oil base drilling fluids. On his return to the West Coast he visited the company's new plant in Wynnewood, Oklahoma, where Black Magic waterless drilling fluid is being manufactured for the Mid-Continent area. In Texas he visited the site for a new plant to be erected in Houston to serve the Gulf Coast area.

COPIES NOW AVAILABLE!

"Those who know you well ... think well of you"

The recent nation-wide opinion survey of the oil industry revealed that harmful criticism exists when people *lack the real facts.* This survey also proved that when people *know* the oil industry, *they think well of it.*

The answers to 39 significant questions ... complete figures ... the most searching factual analysis ever made of the public's opinion of the oil industry, are now available to you in a 272-page book, "THOSE WHO KNOW YOU WELL ... THINK WELL OF YOU."

You can learn what any one of 18 different groups of people—according to income, occupation, etcetera—think of your service, prices, and policies in this clear-cut report. A geographical breakdown gives you the cross-section of opinion for your part of the country.

Here, for the first time, are the facts to blueprint an all-industry plan to offset public misunderstanding.

Every oil man needs the facts in—
"Those who know you well ... think well of you" $4.00

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"A Public Relations Program for the Oil Industry," a 56-page illustrated book, tells about the current oil-industry program as it was described in speeches and forums at the A. P. I. meeting.

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Order your copies now!

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American Petroleum Institute
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oil sets the pace for PROGRESS!

Youngstown appointments

J. W. Owings

G. W. Christopher

The Youngstown Sheet and Tube Company announces the appointment, effective April 1, of G. W. Christopher as manager of standard pipe sales, and J. W. Owings as manager of oil country tubular sales.

Purchases firm

Completion of the purchase on March 31 of the factories and other properties of the Goetze Gasket and Packing Company, Inc. of New Brunswick, New Jersey, manufacturers of metallic gaskets by Johns-Manville was announced by Lewis H. Brown, chairman of the board of Johns-Manville Corporation.

Goetze gaskets will be produced as formerly, at the Goetze plant in New Brunswick and sold by Johns-Manville under the Goetze name. It is also expected that an expanded use will be made of Goetze's plant facilities, skilled craftsmanship, and highly specialized knowledge in the manufacture of metallic gaskets, Brown said.

Combining the products of Johns-Manville and Goetze will result in a complete line of packings and gaskets.

New publication

Covering the wider field of subjects of general interest to the industry as a whole in its I.P. Review, the Institute of Petroleum adds one more to its list of successful publications. This venture deals with all aspects of petroleum, both technical and non-technical, in a way that will appeal to the general reader and not only to the specialist. In these days of specialization, all can benefit from a better understanding and appreciation of work in other fields. The I. P. Review is published at 26 Portland Place, London W. 1, England.

New sales office

The Big Three Welding Equipment Company, Inc., of Fort Worth, Texas, recently announced the opening of its new sales and supply office at 565 West Commerce Street, Dallas, Texas.

This company is a large dealer in all types of welding equiment and accessories, and is one of the largest independent dealers in the country handling equipment manufactured by The Lincoln Electric Company, Cleveland, Ohio.

At the present time, Big Three has sales offices in six of the largest cities in Texas, and in the near future plans to open an office in Beaumont.

Onan PRODUCTS

electricity

. . . . for every oil field job!

Lighting Survey Power Tools Pumps

There's an Onan Electric Plant to meet the requirements of any oil field application—to give long, full-capacity service under the severest operating conditions.

Lightweight one or two-cylinder heavy-duty, air-cooled models for maximum portability. Onan two, four and six-cylinder water-cooled plants for continuous operation, stationary or mobile.

ONAN ELECTRIC PLANTS—A.C.—350 to 35,000 watts in standard voltages and frequencies; D.C.—600 to 10,000 watts, 115 and 230 volts. Battery chargers—500 to 6,000 watts, 6 to 115 volts. ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 h.p.; BH: 2-cylinder opposed, 5.5 h.p.; 18: 1-cylinder, 2.5 h.p.

WRITE FOR SPECIAL FOLDER

D. W. ONAN & SONS INC.

2754 Royalston Ave. Minneapolis 5, Minn.

ONAN ELECTRIC PLANTS

The BIG JOBS by LITTLE UNITS are

"Powered by WISCONSIN"

This pumping unit built by Harley Sales Company is a typical example of a little engine doing a big job. Powered by a Model AK Wisconsin Heavy-Duty Air-Cooled Engine, this dynamic little unit pumps 65 barrels of oil per hour in the newly developed oil field in Cotton County, Oklahoma.

Wherever there is a real power job to be done within a 2 to 30 hp range, you can depend on Wisconsin Engines for heavy-duty service and complete freedom from cooling chores and troubles. Available in single cylinder and 4-cylinder types in a complete range of sizes, Wisconsin Engines are built for use wherever power is needed. For dependable, rugged service, be sure to specify equipment "powered by Wisconsin" . . . *For further details consult Harley Sales Company.*

WISCONSIN MOTOR Corporation

MILWAUKEE 14, WISCONSIN

World's Largest Builders of Heavy Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.

510 Atlas Building, Tulsa, Oklahoma
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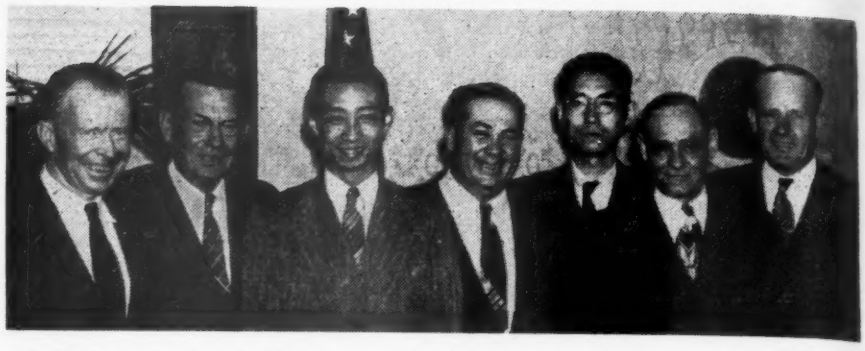
Oil field distributors for Wisconsin Engines and all types of utility units.

L. A. Nomads meet

One of the most enjoyable meetings ever held by the Los Angeles Nomads was the unanimous verdict of the record gang that turned out for Bob Eiche's first handling of the gavel, at the Jonathan Club, on Wednesday evening, March 12.

To begin with, the cocktail hour was handled in a new and, to a Scot, particularly attractive manner, the meal was tops, and Bob and his aides did an excellent job of presiding and providing.

There was a goodly representation of gentlemen from foreign parts, and they were introduced by Henry Pullman in his usual affable style. Among these were



Guests from abroad at the Nomad meeting in March, left to right: Robey H. Deem, Shell of Colombia; G. F. Harvey, Iraq Petroleum Company; C. K. Suez, Chinese Petroleum Company; Charles N. LaMar, Barnsdall-Venezuela; S. J. Liu, Chinese Petroleum; O. H. Shelton, SONJ-Venezuela; Harry D. Huskey, Iraq Petroleum.

Charley La Mar, Barnsdall Oil Company, Venezuela; C. K. Suez and S. J. Liu, Chinese Petroleum Corporation, Shanghai, China; Guy Harvey and H. D. Huskey, Iraq Petroleum Corporation; Robey H. Deem, Shell Oil Company, Colombia; O. H. Shelton, Standard Oil Company of New Jersey, Venezuela.

After a grand dinner and a seventh inning stretch, Lee Laird, the new program arranger, presented Jerry Engstrand, M. C. for the evening, who staged a baseball symposium with Beans (Beans for Boston) Reardon, as the umpire, and Bob Darlick and Larry French to provide the argument.

Beans was in top form, and before the evening was over had ordered everybody in the room to the dugouts, not, however, before they had had a real good time. He was ably assisted in a series of big league reminiscences by Darlick and French, both of whom have had a world of experience as top shots of the baseball world.

Altogether it was an exceptional evening, and if it is indicative of what might be expected under the Eiche regime, the Los Angeles Nomads meetings are going to be mighty popular affairs for the balance of 1947.

Texoma expands

Texoma Supply Company, operating as a proprietorship since its organization in October, 1937, has been incorporated under the laws of Colorado, according to Carl J. Hochenauer, president and founder of the company. The reorganization is a part of the company's plans for expanded facilities and operations to better serve the oil and gas industries.

Other officers of the new corporation are Ray H. Smith, vice president, and Frederick T. Borgwald, secretary-treasurer, who with Hochenauer comprise the board of directors. Smith will also serve as general sales manager.

Hochenauer and associates have been serving the oil industry for 35 years, he having first engaged in the oil well supply business in the Mountain states in 1915.

The company recently moved into larger quarters in the Elliott Building at 120 East 9th Street, Tulsa, Oklahoma. There is no change in the telephone number, local 5-1797 and LD 577.

Because they have built into them the vital, extra capacity for smooth, dependable, trouble-free operation under the severest stresses and strains to be encountered in the world's most powerful machinery, AMERICAN SUPER HEAVY-DUTY ROLLER BEARINGS have been first choice for over 25 years with most manufacturers of heavy industrial and oil country equipment. Brutally strong, simply constructed, precise—AMERICANS give continuous, 24-hour-a-day service for maximum periods with minimum maintenance, often outlasting the equipment itself. Once adopted, no manufacturer has ever had to switch from AMERICANS.

Write for specifications or send us your requirements for analysis and recommendations. Our engineering experience is at your service without obligation.

AMERICAN ROLLER BEARING COMPANY
PITTSBURGH, PENNSYLVANIA
Pacific Coast Office: 1718 S. Flower Street, Los Angeles, California

AMERICAN Heavy-Duty ROLLER BEARINGS

To manufacture in Texas

In line with previously announced expansion plans, the Hammond Iron Works of Warren, Pennsylvania, fabricators of petro-chemical tanks and vessels for nearly half a century, announce the acquisition of complete manufacturing facilities at Port Neches, Texas. This plant built and operated by Rubber Reserve Corporation during the recent war, has complete equipment for the manufacture of Hammond's line of API storage tanks and chemical processing vessels, as well as the well known Hammond vapor-lift, globe roof low pressure tanks and other products of exclusive Hammond design.

In addition to the manufacture and fabrication activities, a full construction organization will be maintained for field erection of the various items manufactured by Hammond.

The plant at Port Neches not only serves the requirements of petroleum and chemical industries of the southwest, but also may be used for export operations. Supplementing current activities in this country, Hammond has extended its foreign work to include substantial contracts in the Far East and South America.

OCT changes

Oil Center Tool Company, Houston, Texas, has announced the appointment of Rex Galloup to the position of West Texas sales representative. Galloup is

Rex Galloup

Ira Wells

widely known in that area, having served Orbit Valve Company in a similar capacity for several years before joining the Oil Center sales staff. He can be reached at 1364-R, Midland.

Ira Wells, veteran OCT sales representative in the West Texas area, has been transferred to the Oklahoma district as sales representative. Wells has established headquarters at Oklahoma City and has telephone number 85995.

Sedberry resigns

T. D. (Dick) Sedberry has resigned as secretary-treasurer and general manager of the Pelican Well Tool and Supply Company, Shreveport, Louisiana, and will no longer be actively associated with the business.

He went to work for Pelco almost 36 years ago. The company had its headquarters then in Oil City, Louisiana, and the old Caddo field was in its heyday. He became a stockholder that same year and soon became an important factor in the business.

Since no treasury stock is available, Sedberry has arranged for a gradual acquisition of his company assets by employes. He wishes to emphasize the fact, however, that his interest in the welfare of the company and the service rendered customers will remain unabated. He will continue to reside at 501 Pierre Mont Road in Shreveport.

Get Accurate Readings of All Tank Levels with Telematic's Guardian **LIQUID LEVEL GAUGE**

TAKE ACCURATE READINGS of all tank levels on your farm in a few minutes, each tank level showing instantly on the Telematic Indicator Panel as fast as you can turn the dial and push the button. Level appears in feet, inches and one-eighth inches in lite-up numerals (finer if desired). Fast, utterly safe, truly accurate, much less costly than hand-gauging, Telematic operates with equally high efficiency in all weather and under any atmospheric condition. Gauges any number of tanks (cone—floating roof—Horton spheroid or sphere—Graver—balloon—breather roof) connected to one Telematic Indicator Panel. Distance between tanks or from tanks to indicator panel is not a factor. May be furnished with mechanical gauging unit at each tank or in combination with remote gauging. Also available with communications system for handset telephone plug-in at all points along the line. Write for cost-free Telematic booklet. No obligation.

TELEMATIC CORPORATION

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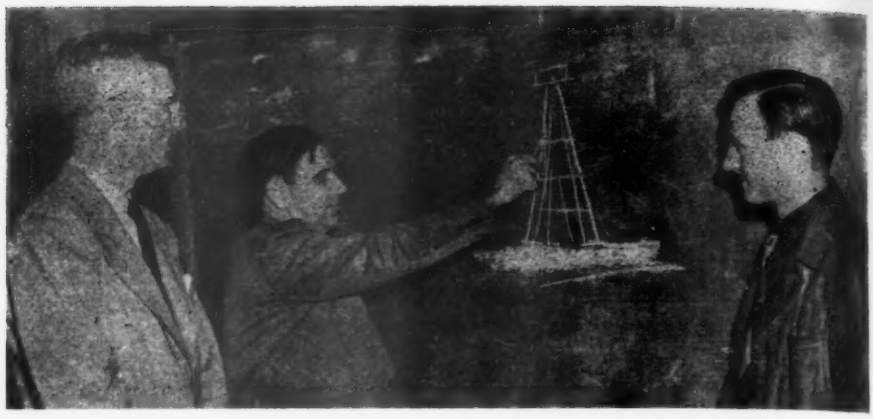
Oil-well drilling course

Kenneth Mills, newly appointed district supervisor of the State Board for Vocational Education, has instituted a course in oil-well drilling practices on the campus of Kilgore College, Kilgore, Texas. The program is being sponsored by the American Association of Oilwell Drilling Contractors.

A program of instruction has been organized by A. W. Paine, and 25 young men have enrolled in the course.



Left to right: Kenneth Mills, A. W. Paine, and Kirby Stevens, a student enrolled in the 12-month oil well drilling class in the engineering department of Kilgore College.

J. F. Berger promoted

E. C. Low, vice president in charge of sales, announces the appointment of J. F. Berger to the position of assistant sales manager, Woven Wire Fabrics Division.

J. F. Berger

Berger has been with the John A. Roebling's Sons Company for 37 years. He has had long experience with the company as a salesman and field engineer for the Woven Wire Fabrics Division.

The appointment of Berger is coincident with a program of expansion in both machinery and products for the Woven Wire Fabrics Division. This expansion is part of Roebling's $6,000,000 investment in modernization and enlargement.

New C.N.G.A. chapter

The formation of a second California Natural Gasoline Association chapter has been announced by CNGA president M. W. Kibre. It will be known as the Coastal Chapter and will meet on the third Wednesday of each month at Ventura. C. L. Case, Continental Oil Company, is chairman, and G. C. Elmore, Tide Water Associated Oil Company, secretary.

The new chapter held its first meeting on Wednesday evening, February 19, in the Southern Counties Gas Company auditorium, with 85 men in attendance. Speaker of the evening was F. W. Hertel, Ventura superintendent for Tide Water Associated Oil Company, whose subject was "The History of the Ventura Avenue Oil Field." Following the talk a colored motion picture, "Drilling Operations in The Swamps of Southern Louisiana," was presented by Fritz Huntsinger of Ventura Tool Company.

Present to wish the new chapter success were Chairman George Howells and H. V. Cowger of the Taft chapter, and CNGA vice president, Frank Colton, George Tyler, secretary-treasurer, David Conklin, membership chairman, and C. L. Hutchings, director, all of the parent organization, Los Angeles.

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(extreme example of possible saving)

250 miles new copper pair = $50,000

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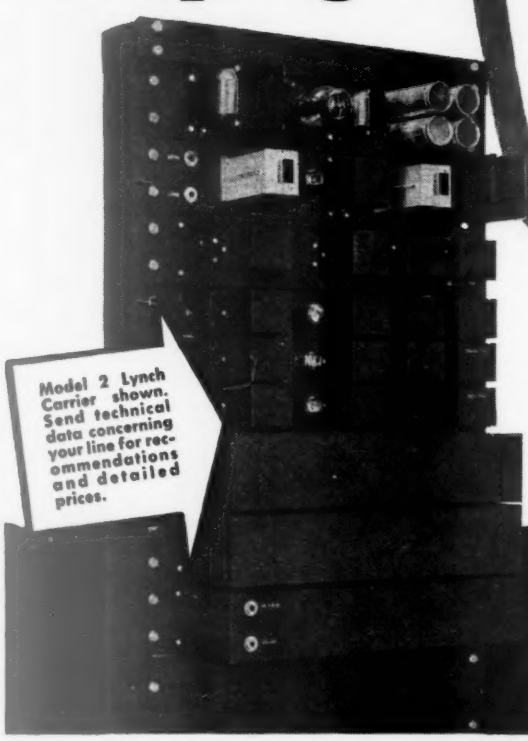
Saved by using LYNCH System = $47,600

If your plans call for any telegraph or telephone line extension beyond 25 miles you'll save by using LYNCH Carrier Equipment every time!



Model 2 Lynch Carrier shown. Send technical data concerning your line for recommendations and detailed prices.

Operates on a standard dial or ring-down basis

The Lynch Carrier System is the newest and most advanced equipment of its kind. It is easily installed, economical to maintain, and fully automatic in operation. Uses only standard tubes which are available everywhere. Lynch Carriers can double, triple or quadruple the number of voice channels over any pair of copper wires. By adding Repeaters, lines 1000 miles long can be handled. Proven through extensive service with major railroads, independent telephone and oil companies. All Lynch Equipment arranged for standard rack mounting.

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New C.N.G.A. secretary

E. R. Millett, Jr.

The appointment of E. R. Millet, Jr., to the office of secretary-treasurer of the California Natural Gasoline Association has been announced by M. W. Kibre, association president. Millett takes over the office made vacant by the resignation of George L. Tyler, CNGA secretary-treasurer for the last nine years. He is a graduate of Pomona College and brings to CNGA a valuable background of experience in the petroleum industry and in organizational work.

Millett is a veteran of World War II, having served with the Army in Japan and Korea. He was honorably discharged from the service as a captain in December, 1946.

For ten years prior to the war he was in business as a consulting petroleum engineer, working on drilling and production problems in California and Oregon. This was preceded by three years' experience with the Union Oil Company and one year with Martin Van Couvering.

Magnaflux conference

A Magnaflux Weld Inspection Conference will be held in Chicago, at the Congress Hotel, May 8 and 9. The main purpose of the conference is the exchange of information by those attending, and only a minimum of time will be taken up by Magnaflux Corporation at the outset to present the subject, it is announced. Discussion leaders have been selected from the industry to conduct sessions devoted to specific phases, and time is provided to bring up any additional topic from the floor. Zyglo as applied to welds has also been assigned some time.

Foreign adviser

Colonel Louis Pineau, president of the Permanent Council of World Petroleum Congresses (London), has been named an adviser on foreign business to Houdry Process Corporation, Arthur V. Danner, executive vice president, has announced.

Col. Louis Pineau

Pineau recently visited the Houdry Laboratories in the United States, where his old-time acquaintance with Eugene J. Houdry and associates was renewed. Pineau sailed for Paris recently with Houdry.

An internationally known figure in the petroleum industry, Colonel Pineau, in addition to being president of the Permanent Council of World Petroleum Congresses (London), is administrator general of the Maison de la Chimie (Association of French Chemical Industries) and is honorary president of the French Association of Petroleum Technologists. From 1920 to 1940, when he was removed by the Vichy regime, he directed the National Office of Liquid Fuels in the Ministry of Public Works. Denied active military service because of World War I wounds, Colonel Pineau from the outbreak of hostilities headed the joint Anglo-French Executive Committee for Oil from London. He is dean of the Commanders of the Legion of Honor and holds numerous citations from the French and allied governments.

Colonel Pineau will maintain headquarters in Paris.

A.S.M.E. meeting

The 1947 annual meeting of The American Society of Mechanical Engineers will be held in Atlantic City, New Jersey, December 1-5.

The Chalfonte and Haddon Hall will be the headquarters hotels. They have guaranteed 2700 rooms for the meeting. Usually the attendance totals about 6000 but it is expected to exceed that figure this year. Some 200 engineers, scientists, and industrialists take part in the program consisting of five days of continuous technical day and evening sessions.

Theme for the year's series of meetings was announced as follows: "The Engineers' Responsibility in Increasing National Productivity."

Controlling Corrosion

This machine *double coats* and *double wraps* in *one* operation.
It was developed especially for J-M by Crutcher-Rolfs-Cummings of Houston.

. . . in a single operation

The Johns-Manville machine, pictured here, applies *double* protection against soil corrosion. TWO coats of enamel . . . TWO layers of J-M Asbestos Felts . . . both go on in a single operation as fast as pipelines can be assembled.

This saves money on installation costs . . . savings that continue through years of service because Johns-Manville Asbestos Pipeline Felts are made of time-defying, rotproof asbestos fibres, J-M Asbestos Felts are the most widely used material for guarding enamel against soil stresses and distortion.

For complete information, write Johns-Manville, Box 290, New York 16, New York.

JM PRODUCTS

Johns-Manville *ASBESTOS* Pipeline Felts

Dallas Petroleum Engineers' Club officers

The new officers of the Petroleum Engineers' Club of Dallas, Texas, for 1947, are, left to right: Charles D. Deschner, Continental Supply Company, vice president in charge of membership; Thomas S. Bacon, Lone Star Gas Company, vice president in charge of programs; Dewey A. Jordan, The Atlantic Refining Company, president; H. J. Gruy, DeGolyer and MacNaughton, vice president in charge of arrangements, and R. U. Maddox, Big West Drilling Company, secretary-treasurer.

A.I.M.E. Section elects

At an organizational meeting on March 5, the newly formed Oklahoma City Section of the American Institute of Mining and Metallurgical Engineers elected the following officers for the ensuing year: Chairman, David L. Dooley, Stanolind Oil and Gas Company; first vice chairman, Glenn Stearns, West Edmond Engineering Association; second vice chairman, Dan Howard, Oklahoma Corporation Commission, and secretary-treasurer, Robert J. Beams, Shell Oil Company. All officers are from Oklahoma City. E. G. Dahlgren, Interstate Oil Compact Commission, and Phillip Montgomery, Halliburton Oil Well Cementing Company, Duncan, were elected directors and with the officers will serve on the section's board of directors.

Charter for the new group was recently approved by the national organization. The section embraces all of Oklahoma except the northeastern quarter, and the Texas Panhandle.

To new quarters

The Knight Manufacturing and Supply Company, Tulsa, Oklahoma, has moved to new and larger quarters at 307 South Cincinnati Street. This concern is headed by Dean Knight and Frank Monahan, both of whom are widely known in the oil industry. The principal products handled by the company include Hewitt mechanical rubber goods, Gardner-Denver pumps, compressors, and a general line of supplies.

New Completions, REDRILLS, OLD WELLS . . .
HOW COME OIL GOT THROUGH SO EASILY?
THAT'S SIMPLE, I JUST LIQUIDATED OLD MR. GUNK!
OIL
MR. HI-PERM
TREAT WHEN YOU COMPLETE
Consider HI-PERM chemical treatment for all completions. Even those wells that come in "with a bang," produce only through the most permeable sands. The less permeable sands in all wells remain clogged for the life of these wells unless treated. Therefore, to insure minimum damage from high velocity, the whole sand interval should be cleaned with HI-PERM at the very start. Yes sir, for more production, treat when you complete!
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Designed and Handled by Experienced Oil Men
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Tubing collars worn by contact with casing steal the profit out of pumping. Patterson-Ballagh Plastic Tubing Protectors prevent both collar and casing wear. Oil-proof, wear-resistant, insulating. They are pressed onto the collar under pressure and will not come off. Made in all sizes. End your tubing troubles. CALL in your Patterson-Ballagh man.

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Production (Practice) Engineer (1)
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Good Salaries, Living Allowances and Home Vacations on Full Salary.
Single Men preferred, BUT for Key men, married, accommodations will be provided where possible.
STARTING SALARY IN KEEPING WITH EXPERIENCE
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giving full personal education and professional background

OFFICE ADMINISTRATOR

Venezuela. Large refinery construction project. Supervise English and Spanish speaking personnel. Must know Spanish. Salary $600. per month plus maintenance and $1000. yearly bonus. This position requires experience and applicant should be graduate accountant. Accommodations for family within approximately two months.

OFFICE MANAGER

Venezuela. Large refinery construction project. Applicant must have thorough knowledge of Spanish to assist in supervision of Spanish and English speaking personnel. Ability to prepare tax reports and payroll. Also supervise Cost Distribution. Salary $500. per month plus maintenance and $1000. yearly bonus. This position requires an experienced man.

CHIEF TIMEKEEPER

Venezuela. Large refinery construction project. Supervise natives. Must know Spanish. Must be experienced. Salary $400. per month plus maintenance and $1000. yearly bonus.

Address Box 66, care of
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ETHYL PLANT

One complete 4350-gallon lead blending plant with Howe Weightograph and necessary pumps and motors housed in 26′ x 32′ steel building. Two 2500-barrel welded tanks, one 25,000-gallon horizontal welded tank. Office building and bath house. 1500′ of 7′ chain link fence. Pipe of 6", 4", 3" and 2" diameter. Location : East Columbia, Texas. Danciger Oil & Refining Company, Fort Worth, Texas, Phone 2-8104.

PRODUCTION ENGINEER wanted by independent company operating in West and West Central Texas. Excellent prospects for young man having engineering degree and reasonable period of practical production experience. In reply please furnish summary of education and experience, age, marital status, salary desired, and date of availability. Inexpensive photo or snapshot desirable. Address P. O. Box 1727, Midland, Texas.

SITUATIONS OPEN: Chemical Engineers with three to five years' experience in the operation of petroleum refining distillation units, thermal cracking units or catalytic cracking units for work as Technical Service representatives and Operators of commercial catalytic cracking plants. Kindly send details of experience and education. Snapshot (if available). Address Box No. 59, % *The Petroleum Engineer*, P. O. Box 1589, Dallas, Texas.

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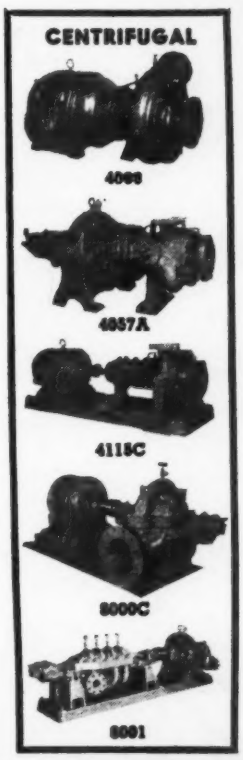

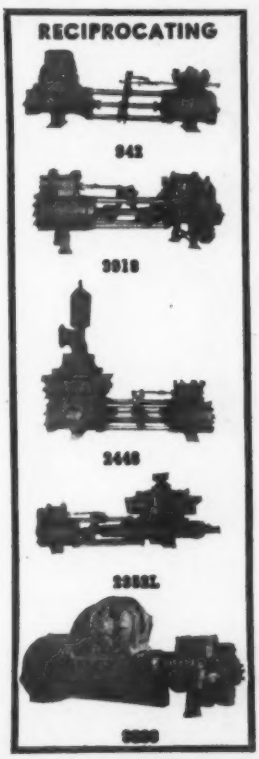

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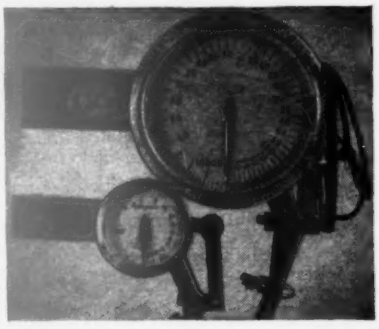
LINE SCALES



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20 MODELS to choose from

With a LINE SCALE you know the pull on the line, and the weight on the bit in pounds. Repeated tests prove the accuracy and dependability of LINE SCALE readings under all working conditions . . . even in areas of rapid temperature changes.

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"ARMSTRONG BROS." Chain Tongs come in "Standard," "Reversible Jaw" and "Ideal" (V-jaw) types—in sizes for every need. Their drop-forged jaws have milled teeth, are hardened, tempered and tested for wearing qualities. They have heavy forged-in lugs that give extra bearing on the handles to which they are rigidly held by a large hardened steel bolt. The handles are forged and heat treated to the correct balance of stiffness and spring. Shackles are drop forged and chains proof-tested to ⅔ catalog strength (3,600 lbs. to 40,000 lbs.).

Write for Chain Tongs Circular

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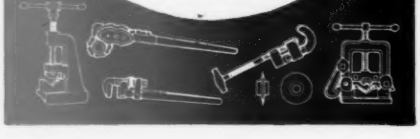

Bowen 25th anniversary

At an anniversary dinner held recently the S. R. Bowen Company celebrated the organization's founding at Huntington Beach by S. R. Bowen in 1921 by presenting employes with pins for five, ten, twenty, and twenty-five years' service. Special recognition was given to J. A. Wilcox, president, S. Siracusa, treasurer, and A. G. Baumbach as these men have been with the company since its inception.

J. A. Wilcox

From Huntington Beach the company branched out to Long Beach, Santa Fe Springs, (where the new manufacturing plant with greatly expanded facilities is nearing completion), Bakersfield, Ventura, Avenal, Santa Maria, and Casper, Wyoming. Export offices are maintained at 30 Rockefeller Plaza, New York City.

The name Bowen covers both S. R. Bowen Company and Bowen Fishing Tool Company—both California corporations. The S. R. Bowen Company manufactures tools that are used in every oil producing country in the world, and the Bowen Fishing Tool Company covers the servicing of the tools to the oil industry of the United States.

C. V. Guinn promoted

Ken W. Davis, president of Mid-Continent Supply Company, Fort Worth, Texas, announces the transfer and promotion of C. V. Guinn, district service manager at Oklahoma City, to the new post of general service manager for the entire organization. Guinn will operate out of the company's general offices in Fort Worth.

Export representative

The Cummins Engine Company, Columbus, Indiana, announces the appointment as export representative the newly formed Mid-Continent Cummins Export Corporation. This new organization is operated by men with long experience in the sales and service of Cummins diesel engines.

Export offices are at 42 Broadway, New York City; 6220 Navigation Boulevard, Houston, Texas; Mid-Continent Building, Fort Worth, Texas; Milam Building, San Antonio, Texas; 811 Howard Street, New Orleans, and in the Petroleum Building, Los Angeles.

PUMPS for PETROLEUM PRODUCTS

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Comes ready to use as is. Needs no special equipment, mixing or expert handling. All active ingredients—saves water analyses—reduces operating and maintenance costs.

Ask For Enough

for a test under your regular operating conditions. If not entirely pleased with results, you will owe us nothing. Guaranteed harmless to personnel and equipment.

Write Today

"The Entirely Different Boiler and Engine Treatment"

AMERICAN SAND-BANUM COMPANY, Inc.
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To manage Pacific Coast operations

Robert A. Neal, vice president of the Westinghouse Electric Corporation, has been named general manager of the company's expanding Pacific Coast operations, according to Gwilym A. Price, Westinghouse president.

Appointment of a chief executive officer for the Pacific Coast, reporting directly to the president, is dictated by expansion of the company's operations there and involves no change in the personnel or duties of those now in the company's employ in that section, it is announced. Westinghouse at present is completing lease arrangements to operate the Sunnyvale, California, plant of the Joshua Hendy Iron Works. Other West Coast Westinghouse plants are at Los Angeles and Emeryville, California, Portland, Oregon, and Seattle, Washington.

Robert A. Neal

Now in his 37th year with Westinghouse, Neal has been a leading figure in the development of switchgear equipment, fostering improvements that have enabled power companies to meet the increasing demands for electric current at steadily decreasing consumer costs.

Recipient in 1937 of the Westinghouse Order of Merit, his company's highest award for meritorious achievement, Neal was named vice president in May, 1944.

Holcomb new P&H sales manager

Harnischfeger Corporation of Milwaukee, Wisconsin, builder of P&H products, has announced the appointment of Ralph D. Holcomb as general sales manager. He will direct the sales of all P&H products, excavators, road machinery, hoists, cranes, and welding equipment.

Holcomb's elevation to his new post follows 18 years' continuous service with the P&H organization. During this period, he has directed sales in many sections of the country, including Wisconsin, New York, Pennsylvania, Missouri, Tennessee, and, finally, California, his latest position being that of district manager for the San Francisco territory.

In addition to his long experience in field activities, Holcomb also served as sales manager of P&H's large excavator division from 1940 until 1942.

Sign license agreement

Licensors during the war permitted the majority of units to be installed prior to signing formal license agreements. Houdry has just completed signing of license agreements covering all fixed-bed and TCC units in the world, with the execution of an agreement with Sinclair Refining Company. Shown at the formal signing are left to right (seated) R. F. Adams, Sinclair patent counsel; A. V. Danner, Houdry executive vice president; and Curt Von Boetticher, Sinclair patent counsel; standing: P. M. Quilleret and G. A. Kessler, treasurer and patent counsel, respectively, for Houdry Process Corporation.

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Pacific Personalities

Recently we were invited to the home of Jim Moon up in Altadena, to say au revoir to John de Hetre, as he leaves for Youngstown, Ohio, where he will take over as special development engineer for Youngstown Sheet and Tube Company. It was our first visit in the neighborhood of the Moon diggings, and we were cruising along the street with our eyes well out to catch the right number, when suddenly, through a large window, we sighted some 20 fishermen practicing fly fishing and other piscatorial acrobatics in a space about four feet by four, in the middle of somebody's living room. It was an amazing spectacle, and the more we think about it even now, the more we are convinced that there has never been such a frenzy of congestion since the Black Hole of Calcutta.

Knowing the Waltonian proclivities of engineers in general and this gang in particular, we barged in, and in no time at all were caught in the middle of the melange, with fish hooks flashing menacingly past our good ear, reels whirring and unwhirring with utter abandon, and the air gradually stiffening with a babel of sound that reminded us of a Sumatran souk (That's "market place," son). Through the conversational smog, we could dimly see Ben Bayliss, vice president of Waldrip Western, who, it is whispered by the Winchells of the equipment business, is about to become a father. Ben was examining the biggest fishing fly we have ever seen. The feather was a rabbit's foot, and the hook looked as though, with a safety latch, it might be a useful gadget on a drilling rig. It was apparently built by the boys as a parting gift for John de Hetre, and we'll swear if he ever drops the thing in one of these eastern lakes, the surrounding country is going to be inundated no end.

When an occasional light libation had reduced the boys to comparative quiescence, other members of the party began to take recognizable shape, and it turned out to be quite a high powered congregation. There was John O. Hills, for example, the only man who ever dropkicked a steelhead out of the Santa Ynez river right onto the frying pan. John is currently interested in a big transportation deal—transporting the Petroleum Production Pioneers to their barbecue at Bakersfield on May 3, and besides that is active in a dozen and one other petroleum organizations and committees. He is one of General Petroleum Corporation's top engineers, and is held in high repute by western oil men.

Another flying horseman much in evidence was Tom Atkinson, who has already been cited in this column for good behavior. Tom was due to leave right after the party for New York to attend the AIME annual meeting, which may explain why he encouraged Fred Hummel to tell so many stories. It is probable that he needed some to take back with him. Fred is field engineer for Shell Oil Company at Bakersfield, and is an authority on the operation and maintenance of internal-combustion engines. He has perhaps the most extensive repertoire of after dinner stories in the west, which is taking in quite a bit of territory, and he does not hesitate to tell an after-dinner story before dinner if he can find a receptive audience.

Altogether, this was just about as interesting a group of aspiring engineers and perspiring fishermen as you'd find in a day's march. There was Ed Wagner, to get specific, another Waldrip Western executive—quiet, unassuming, but with an unusually inventive mind. During the war, Ed was attached to the Office of Scientific Research and Development, and became one of the allied authorities on artificial limbs, a comprehensive study of which carried him to most of the approachable capitals of Europe. Then there was Dan Johnston, drilling superintendent of Signal Oil and Gas Company, who doesn't tell so many stories but is an expert stimulator and listener, and on his many fishing trips has always managed to make good copy for story tellers.

Charley McClure was also present in person. He is the new field engineer for Youngstown, and will take over when John

de Hetre goes east, which will be before this goes to press. From all accounts there is no doubt that Charley will give a good account of himself. Incidentally, he admits that there are still a few tartan corpuscles running riot in his blood stream, and although the Caledonian influence is a generation or two removed, his favorite music is still the tinkle of the cash register.

Another orator of great promise who held forth nobly in this congregation was Glen Johnson, Baash-Ross Tool Company chief engineer, and the Balzac of the oil industry. Glen has adventured far and daringly in gathering his fine collection of droll stories, and is a mighty good entertainer. Some day we hope to promote a research project that will have for its objective the completion of a chronology of oil-field humor. When we get this worthy enterprise under way, Glen and Fred Hummel will certainly be on our board of directors.

Offering strong encouragement to these narrators were other well known men in the engineering profession, including Bill Bates, Shell Oil Company drilling engineer, who took to his kind of work after he heard that a drilling crew will often spend several weeks on a fishing job; Bill Chonnette, The Texas Company mechanical engineer, and golfer of repute. The latter, incidentally, has planned a golf course with trees and traps down the middle and fairways out on both sides. "Might as well make the easy going where you spend most of your time," Bill opines, and it sure sounds logical enough.

Also glimpsed in the circle around the pop corn bowl, and obviously having a good time, were Bob Baker, mining engineer, and John Shaw, design engineer for Waldrip-Western. At frequent intervals, Mine Host Moon entered with steaming flagons of old Malmsey or something, and for some reason or other every trip would remind him of a limerick. If it didn't happen to remind him, by some queer freak of circumstances, he told a couple of limericks anyway. This, of course, excited the limerick remembering glands of the other guests, with the inevitable result that all prior limerick reciting records were reduced to a vulgar fraction. It is our earnest intention to launch a contest between Bill Heater of Baroid in this corner, and Jim Moon in that one, and we are going to make the suggestion here and now that Lee Laird book these lads for a tussle at one of the Nomad meetings. They are without question the two best limerick rememberers on the west coast, and an open bout for the championship would be an attraction that would bring in limerick lovers by the hundreds. Returning to the main theme, however, it was in all respects a night to be remembered, and no doubt as he sits on the banks of the Ohio, casting that monstrous fly at the frightened fish, John de Hetre will look back with fond recollection, to his farewell party in Altadena.

●

Earle Noble, Cy Dobbin, Harold Hoots, Bob Atwill, and all the leading mud smellers, foraminifera chasers, and seismologists in the AAPG, SEPM, and SEG are tickled no end over the success of the annual meeting. According to the Chamber of Commerce, and they have never been known to exaggerate, there were 1850 all told in Los Angeles for the big event, and apart from the numerical showing it was a most productive affair from a scientific standpoint. Among the more remote visitors—we mean, of course, visitors from more remote sections—were such luminaries as Mose Knebel, from Standard of New Jersey, New York; Dale Condit, Standard Vacuum, New York; K. C. Heald, Gulf Petroleum, Pittsburgh; Glen Ruby, Herbert Hoover, Jr., and Duke Curtice, transplanted Californians, now New Yorkers; the famous geological partners, "Dee" DeGolyer and Lewis MacNaughton, Dallas; Leonard Orynski, Standard of Texas, Houston, and an endless procession of greats in the geological world. Every item in the scheduled program of events went off without a hitch, and the committees that took care of arrangements are to be congratulated on their thoroughness. From our particular standpoint, special commendation is coming to Gordon Bell, Western Gulf, for a flawless job as publicity chairman. Publicity is a bit foreign to geologists and people of their ilk, but Gordon performed like an old hand and made it pretty easy for the press to do a good job of reporting, and there is no question that he produced results. The entire meeting had excellent coverage in the press as well as the trade papers.

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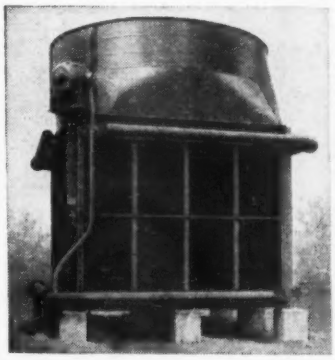

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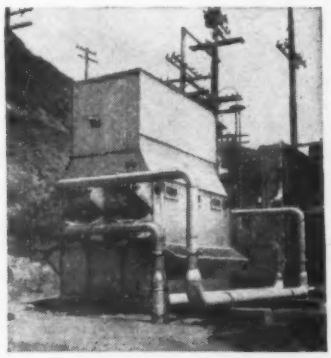

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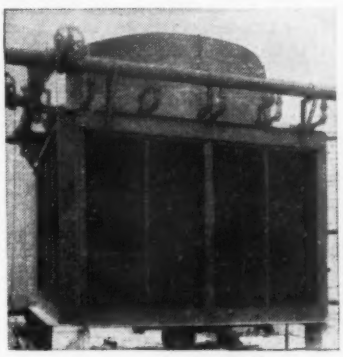

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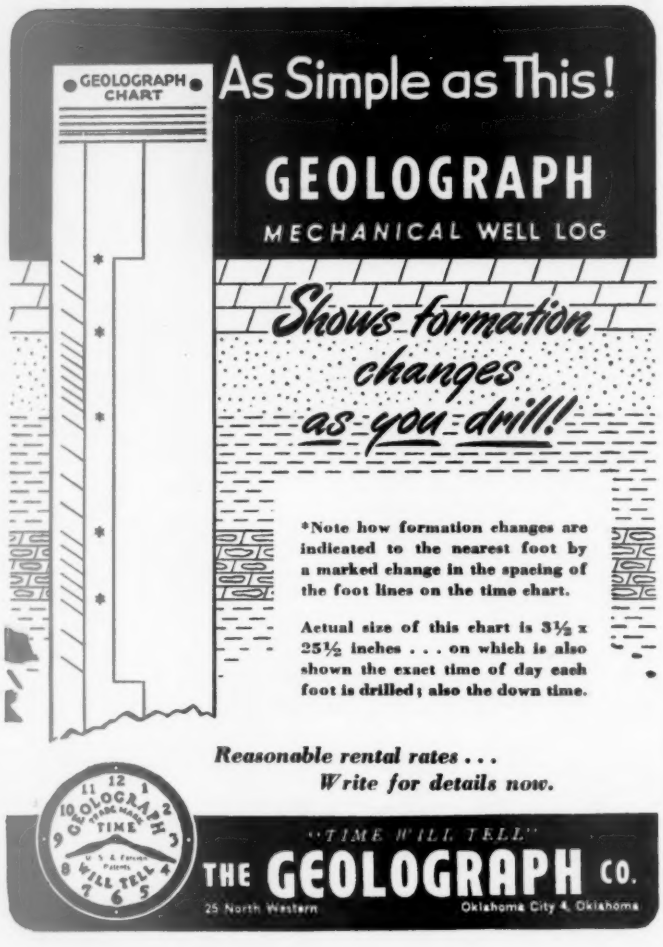
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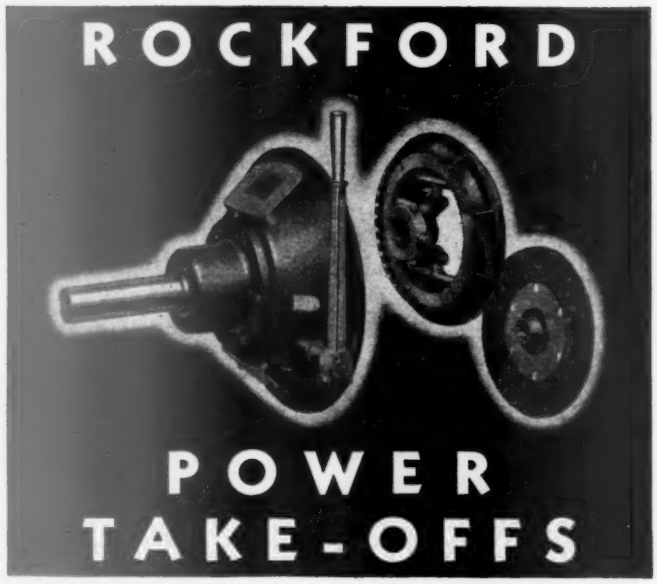
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Houston Nomads meet

Foreign visitors attending the March meeting of the Houston Chapter Nomads are shown in the accompanying photograph. Left to right, they are: L. R. Leard, Socony-Vacuum Oil Company, Cucuta, Colombia, S. A.; R. N. Posgate, Shell Oil Company, Maracaibo, Venezuela, S. A.; D. D. Lewis, Calgary, Alberta, Canada.

Jerry Rice, vice president of Tennessee Gas and Transmission Company, was the chief speaker of the evening. A technicolor movie entitled "Gas," showing many of the construction details of TGT's gas line from Texas to West Virginia was shown.

Another speaker, Ray L. Dudley, publisher of *The Oil Weekly*, gave the Nomads some facts relating to the world oil situation that he had gleaned from an extended stay in New York.

Jas. P. Marsh declares firm price stand

The Jas. P. Marsh Corporation of Chicago is one organization willing to take a firm stand against the inflationary trend of industrial pricing. In plain terms of guaranteed prices the Marsh management has declared a "firm price policy" in the sale of Marsh products such as pressure gauges, dial thermometers, packless valves, traps, vents, and related steam heating specialties. Any prices of Marsh products quoted henceforth during 1947 will not be subject to any increase above the prices in effect on the date the order is placed, it was stated.

Commenting on the program, the heads of the Marsh organization stated that it was a difficult decision to make in view of the risks involved. "We have come to the conclusion, however," said Barrett Scudder, president, "that it is about time for buyers to be told what they are going to pay for the products they buy. Our idea is to give our customers a taste of prewar price stability. It seems to us that the hazards involved in establishing firm prices must be assumed by the nation's manufacturers if the spiraling of prices is to be checked and the pitfalls of inflation are to be avoided. Insofar as possible we are asking our suppliers to cooperate in the firm price program to protect our position. If we can contribute even in small measure to the return of sound business practice and forthright competition, the risk we have assumed will have been well rewarded."

Arabian American changes

H. D. Collier, chairman of the board of the Arabian American Oil Company, has announced that F. A. Davies, who was one of the pioneers in the development of production in Arabia, has been relieved of the administrative duties in connection with the office of president, so that he can concentrate his efforts on the development of production necessary to fill the new pipe line and to take care of other markets now being so rapidly developed by the Arabian American Oil Company. He has, therefore, been elected vice president in charge of production and exploration and will devote his time primarily to these activities. Davies was among the first of the engineers and geologists to enter Arabia and has directed the development of the company's activities since the beginning.

W. F. Moore, general manager of the foreign operations of The Texas Company, has been elected president of the Arabian American Oil Company. Moore, a native of Georgia, entered the service of The Texas Company in 1920 as an assistant power plant operator in the Texaco refinery at Port Arthur, Texas.

● **Those Who Know You Well . . . Think Well of You, Report of Public Opinion of the Oil Industry—1946.** *Published by the American Petroleum Institute, 50 West 50th Street, New York 20. Pages 272. Price, $4.00.*

What the public thinks about the oil industry is reported in an exhaustive survey of 10,000 adults. This is one of the most comprehensive nationwide opinion surveys ever made for any industry. The volume is divided into three sections: (1) A brief discussion of the most important findings; (2) a summary and analysis of all the results; and (3) the complete, tabulated returns from all the questions.

In many respects large parts of the public do not understand how the oil industry functions and consequently have unfavorable opinions about it. Their answers reveal the attitude of the public on important phases of the industry and the knowledge of the public on facts about the industry. Current oil industry public relation programs are based primarily upon this survey.

Results of the survey are broken down into 18 different categories so that public opinion and knowledge on each question may be determined, not only by sections of the country, but also by producing and refining areas, sex, age groups, race, urban or rural, type of employment, income level, union membership, politics, car owners, oil-industry employes and influence groups.

● **Learning to Weld.** *Published by The Lincoln Electric Company, Cleveland, Ohio. Pages, 32. Price, 25c in U. S., 35c elsewhere.*

Providing a simple basic approach for anyone making a start in arc welding, the information contained in this booklet shows clear insight into important aspects of the subject. Its purpose is to teach how to weld and to assist in applying arc welding to the repair of broken parts, the hard surfacing of worn parts and the building of miscellaneous equipment.

Subjects treated include the following: Protective clothing and equipment, striking the arc, various welding positions, types of welds, fit-up of parts, procedures for various welds, welding cast iron, and hard surfacing. With 83 illustrations, conversion tables on decimal equivalents and thicknesses of metal, and a glossary of welding terms, this book is a good basic study.

● **Portland Cement Technology,** *by J. C. Witt. Published by the Chemical Publishing Company, Inc., 26 Court Street, Brooklyn 2, New York. Pages, 510. Price, $10.00.*

One of the few books on cement, this valuable book is supported by years of experience in many phases of the technology of portland cement and some other materials. It traces the development of cement technology from its early rudimentary stages to its present highly scientific status.

Each chapter is based primarily on materials rather than plant equipment, and has been reviewed by an expert on the special phase of cement manufacture discussed. Much information on every step of cement manufacturing is given. Chemist, technical worker, and engineer will all find good general knowledge of the technology of portland cement in this book.

● **Research in Canada, Planning for the Coming Years,** *by the Chemical Institute of Canada. Published by Imperial Oil Limited. Pages,* 160.

In a discerning manner, able Canadian thinkers survey the fields of scientific research and the result is recorded in this volume. These papers, given at a symposium of the Institute, discuss freely the difficulties of organization and the expense of modern industrial research, with special reference to the problems of the executive of a small manufacturing unit.

The loss of hundreds of young Canadians, trained for a scientific career, to their neighbor of the south is faced with due misgivings. To remedy this ill, the support and encouragement of the universities is recommended, as well as education and opportunity for youth in research.

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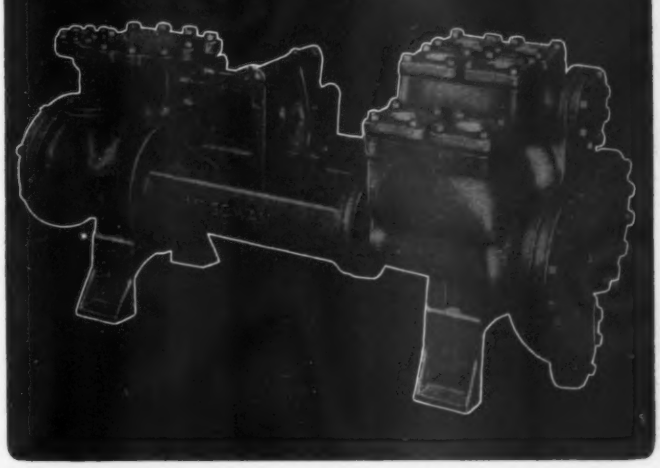

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